

2005

Industrializing the Corn Belt: Iowa farmers, technology and the Midwestern landscape, 1945-1972

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Industrializing the Corn Belt: Iowa farmers, technology, and the
Midwestern landscape, 1945-1972

by

Joseph Leslie Anderson

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Agricultural History and Rural Studies

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Iowa State University
Ames, Iowa
2005

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For the Major Program

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INTRODUCTION

Iowa's rural landscape of today bears only slight resemblance to that of 1940. The similarities begin and end with the fact that much of the land is still used for agricultural production and of the land in production much of it is devoted to corn. To anyone who lived in the Iowa countryside or has studied its history, the first difference that attracts notice today is the lack of people. Except for spring and fall, it is possible to drive through rural parts of the state without seeing anyone except other travelers on the road. The days of passing several farmsteads each mile with people working outdoors in fields and farmyards are gone. Almost every farm family of 1940 would have kept a variety of livestock in lots and pastures, visible to passersby. In the twenty-first century it is possible to cross an entire county without seeing livestock, depending on the time of year or the route. Even fields look different. The old crop rotations of corn, oats, and hay are gone, as well as other crops such as flax. Today, corn and soybeans dominate, packed in dense plant populations, a sharp contrast with wide rows of the 1940s. There is still a large portion of the state's acres planted to hay and pasture, but high land values require high returns from cash crops in modern agriculture. Finally, an ever declining number of barns, houses, and outbuildings are testimony to a kind of agriculture practiced by an earlier generation. The decay of many of these buildings indicates their obsolescence in modern agriculture.¹

From 1945 to 1970 Iowa farmers remade their physical and social landscape. They purchased, borrowed, or hired new machines, remodeled existing outbuildings or built new ones, changed crop rotation strategies, and began using purchased chemicals such as

¹ Lowell Soike observed the differences between contemporary and historic farm landscapes in the introduction to his essay, "Viewing Iowa Farmsteads," in *Take This Exit: Rediscovering the Iowa Landscape*, ed. Robert F. Sayre (Ames: Iowa State University Press, 1989), 154.

pesticides, fertilizer, and feed additives to meet changing conditions on the farm and beyond. Farmers scrambled to find ways to increase production by maximizing yields and gains while simultaneously minimizing losses in the boom times of World War II through the Korean War. After the Korean War, farmers continued to increase production by using new technology, but this time they did so during a “cost-price squeeze” in which real prices for what they produced declined faster than prices for what they purchased. All the while, they altered work patterns to accommodate new technology and changing social expectations. Farm families received a great deal of advice and assistance from agricultural extension professionals, advertisers and manufacturers, journalists, and bankers, but they were the ones who made the decisions that altered the nature of the Midwestern landscape.²

Throughout the twenty-five year period after World War II, Iowa farm families were leaders in industrializing agriculture with new tools and techniques. This was in sharp contrast to the years the 1920s and 1930s, when, as historian Deborah Fitzgerald noted, outsiders such as college educated experts, journalists, and industry leaders were the most vocal proponents of changing the ways farmers worked. According to Fitzgerald, these outsiders encouraged farmers to adopt an industrial model of “large scale production, specialized machines, standardization of processes and products, reliance on managerial (rather than artisinal) expertise, and a continual evocation of ‘efficiency’ as a production mandate.” While farmers in the Midwestern Corn Belt did make some changes during these years, most notably purchasing tractors and using hybrid seed corn, they balanced new

² Richard G. Bremer argued that after World War II farmers in the Loup River country of Nebraska used technology to manage the risks of farming in turbulent times. See *Agricultural Change in an Urban Age: The Loup Country of Nebraska, 1910-1970* (Lincoln, NE: University of Nebraska, 1976), 202. The rural Midwest in the postwar period deserves more study. For a survey of farm changes in Ohio after World War II, see R. Douglas Hurt, “Ohio Agriculture Since World War II,” *Ohio History* 97 (Winter-Spring 1988): 50-71.

technology with “making do.” The 1920s and 1930s were years of limited change in the Corn Belt.³

During the depression, farm families could not afford to make the kinds of changes outsiders recommended even if they wanted to do so. They survived with what they had at hand and depended on kin and neighbors to meet their needs. As depression gave way to war in the early 1940s, however, conditions began to change. Congress promised to support commodity prices in 1942 while simultaneously encouraging maximum production, and farmers began to earn enough income that they could look beyond meeting immediate needs. During the war, there was little opportunity to spend the income they made by producing at record levels for guaranteed prices. In 1945 farm families that paid off debts were ready to reinvest in their farm operations. People feared the next farm depression, just as they and their parents experienced after World War I, but they also prepared for a new world in which technology would help them solve problems.⁴

The new world of agriculture was different both in terms of physical landscape and the social landscape. By the 1970s, new machines, chemicals, and buildings replaced human hands, older machines, and outmoded buildings. The application of herbicide, insecticide,

³ Deborah Fitzgerald, *Every Farm a Factory: The Industrial Ideal in American Agriculture* (New Haven: Yale University Press, 2003), 22-23.

⁴ Several studies provide insight into the ways farm families persevered during the Great Depression. Mary Neth detailed the ways in which Midwestern farm women “made do” to preserve their farms, while Pamela Riney-Kehrberg documented the ways in which Kansas families managed to stay on farms and small towns in the Dust Bowl. Katherine Jellison showed how Midwestern women used technology to reinforce their roles as family producers rather than consumers during these years. Mary Neth, *Preserving the Family Farm: Women, Community, and the Foundations of Agribusiness in the Midwest, 1900-1940*; (Baltimore: Johns Hopkins University Press, 1995); Pamela Riney-Kehrberg, *Rooted in Dust: Surviving Drought and Depression in Southwestern Kansas* (Lawrence: University Press of Kansas, 1994); and Katherine Jellison, *Entitled to Power: Farm Women and Technology, 1913-1963* (Chapel Hill: University of North Carolina Press, 1993). Alan I Marcus and Howard P. Segal described the mood of post World War II optimism about technology in *Technology in America: A Brief History* (San Diego: Harcourt, Brace, and Jovanovich, Publishers, 1989), 309-311.

and fertilizer was standard on almost all Iowa farms. A growing percentage of farmers used feed additives to cut livestock production costs. Threshing machines, corn pickers, stanchion milking barns, feeding livestock by hand, and the practice of storing loose hay were obsolete or on their way to becoming obsolete by the 1970s. Farmers planted more acres in corn and soybeans and fewer in hay and small grains, while new crop and insect pests made their homes in Iowa's fields and farmyards. Farmers of 1972 confronted new government rules about how they should conduct their business, especially the application of chemicals to land, crops, and livestock, and the management of livestock waste. The farm population was also shrinking at a rapid rate, with farmers either retiring or refusing to make some of the investments needed to stay in business in a changed world.

Stories of agricultural change have been told many ways, but the ones that have been told first and in depth have been about institutions and people with the most education, since these groups and individuals left the most records. This study tells the story from the perspective of the people who raised the crops and livestock, just as Allan Bogue did in his 1963 study of farming in Iowa and Illinois during the nineteenth century. Bogue focused on the farmer "with dirt on his hands and dung on his boots---and the problems and developments that forced him to make decisions about his farm business." But histories like Bogue's, emphasizing how people used cows, plows, and sows to make a living have fallen out of favor of the last few decades. A new generation of historians rightly brought innovative and previously neglected perspectives on rural life to the forefront. Most of these new studies, however, do not place production agriculture at the center of the story. As historian Robert McMath observed about rural social history, "Crops are grown and they are harvested. But with what, how, and by whom?" The details of agricultural production and

what they can tell us about rural people are too often left behind. In 1985 Pete Daniel called for historians of Southern material culture to “investigate the houses and tools that farmers used. Oral historians have time left to quiz farmers and former farmers on the old ways, and students of documentary photographs can analyze images from the past.” The chapters that follow allow us to not only learn something about farmers and changes in rural life; we can learn about one of the most tremendous productive transformations in American history.⁵

This transformation occurred after a period of relative consistency in agricultural production and techniques that lasted from around 1900 to the 1940s. By 1900, most Iowa farmers had moved beyond the farm-making phase of agriculture, with most Iowa land cultivated, grazed, or managed in woodlots. Farmers of the mid to late 1800s learned that they needed to apply manure to their fields and practice crop rotation, including tame grasses and legumes between crops of corn and small grains, to keep production up. During the nineteenth century, farmers phased out most of their pioneer buildings, fenced most of their fields and pastures, and used implements such as chilled iron plows, grain binders, threshing machines, and manure spreaders to farm a larger portion of their acres. These practices were common on Iowa farms at the end of the nineteenth century.

⁵ Allan G. Bogue, *From Prairie to Corn Belt: Farming on the Illinois and Iowa Prairies in the Nineteenth Century* (Chicago: University of Chicago Press, 1963), 1; Robert C. McMath, “Where’s the ‘Culture’ in Agricultural Technology?,” in *Outstanding in His Field: Perspectives on American Agriculture in Honor of Wayne D. Rasumssen*, ed. Frederick V. Carstensen, Morton Rothstein, and Joseph A. Swanson (Ames: Iowa State University Press, 1993), 125; Pete Daniel, *Breaking the Land: The Transformation of Cotton, Tobacco, and Rice Cultures since 1880* (Urbana: University of Illinois Press, 1985), xv-xvi. This study puts users at the forefront without denying the importance of chemical manufacturers and extension professionals in the process of technological adoption. For Iowa farmers during the postwar years, herbicide was a product that would help them maximize production and reduce labor. As the following pages demonstrate, the fact that farmers used technology in ways that were not prescribed by manufacturers and experts suggests that they domesticated technology in the ways described by Nelly Oudshoorn and Trevor Pitch. See *How Users Matter: The Construction of Users and Technologies* (Cambridge: The MIT Press, 2003), 14-15.

While there were many changes in farming and farm life between 1900 and the outbreak of the World War II, in many ways farmers' relationship with technology and the ways in which they grew crops and raised livestock remained much the same as they had been at the turn of the century. The internal combustion engine, used for stationary power in the farmyard and as tractors in the fields, replaced many (but not all) horses before 1940. Farmers used tractors for heavy work such as plowing and disking or belt power, but continued to use horses for cultivating, hauling feed, and numerous other jobs. Even though the tractor replaced many animals in the 1920s and 1930s, it did not necessarily alter farm production. Most farmers rarely used implements especially designed for tractors. Instead, they modified older, horse-drawn equipment for use with tractors. More importantly, farmers still needed to practice the same type of corn, small grain, and forage crop rotation to prevent depletion of soil nutrients and build-up of weed populations and insect pests. Even though farmers needed less hay and oats to feed horses due to the adoption of tractors, they still needed a multi-year rotation system of different kinds of crops. Farm size, the number of acres cultivated, and number of farms were relatively constant from 1900 to World War II, indicating that tractors were not used to enlarge farms during this period. Instead, farmers used tractors to cut operating costs by using a power source that only needed to be "fed" when it was used rather than to expand production. Farmers did not utilize the full potential of tractor power until after World War II, when the mechanical and chemical changes depicted in this study became common. The most important change in production of the interwar years was transition to hybrid seed. Few farmers used hybrid seed when it was introduced commercially in the 1920s, but virtually all Iowa farmers planted all their corn acres with it by 1942. Yield gains through the use of hybrid corn partially offset losses

through government acreage reduction programs and helped farmers meet the increased demands of wartime production.⁶

World War II fundamentally changed the old systems, marking a significant shift in the use of technology to replace human labor and to expand the scale of production. Manpower shortages, high production goals, government-sponsored research, and the social aspirations of a new generation of farmers combined to bring about a significant change in the way farmers raised crops and livestock. Farmers in the postwar Midwest decreased production costs by substituting machines for labor, using pesticides to destroy weed and insect pests which were obstacles to high crop yields and livestock gains, fertilizing fields with chemicals, installing automated feeding systems, and adding new feed supplements that accelerated animals' ability to absorb nutrients and calories. During these years members of farm families sometimes did jobs in hours or days that used to require days or weeks of work, often with the help of full time hired men and/or itinerant laborers. Farmers severed many of the ties to the agricultural production techniques of their parents' generation by 1970, creating a new physical and social landscape characterized by larger farms, larger herds, altered crop rotation and plant populations, more specialized production, rural out-migration, and a lifestyle that more closely resembled that of their urban and suburban counterparts.⁷

⁶ Allan G. Bogue argued that important changes took place in the production in the Corn Belt between 1900 and 1939, including the adoption of the tractor, hybrid seed corn, and the mechanical corn picker. These changes were important, but farming in 1940 looked so much like farming in 1900 that a person who successfully operated a farm in 1900 could successfully operate the same farm in 1940 without changing management or production strategies. "Changes in Mechanical and Plant Technology: The Corn Belt, 1910-1940" *The Journal of Economic History* 43 (March 1983): 2.

⁷ Wayne Rasmussen labeled this period the second agricultural revolution. "The Impact of Technological Change on American Agriculture, 1862-1962," *Journal of Economic History* 22 (December 1962): 588. Changes in agricultural production occurred worldwide as farmers in industrialized nations applied industrial ideals to agriculture. For a comparison of how this process occurred in the German Federal Republic and German Democratic Republic, see Arnd Bauerkamper, "The Industrialization of Agriculture and its Consequences for the Natural Environment: An Inter-German Comparative Perspective," in Frank Uekotter,

One of the most important developments that provided farmers with the motivation to substitute machines and chemicals for labor was rising labor costs. This nationwide trend toward military service and urban employment accelerated during World War II. Regular paydays and the prospect of overtime wages were attractive to many people who had previously been content with farm employment. In 1945 a writer for the state report on agriculture noted that while farm wages in 1945 were the highest ever paid, there were record labor shortages. This problem continued through the 1960s. Even though farmers increased wages, compensation for farm workers was far below jobs in manufacturing, construction, and truck driving. Higher wages in other sectors of the economy put pressure on farmers to pay more for labor.⁸

This decline in the numbers of farm laborers coincided with changes in educational attainment and career possibilities in the postwar period. High school graduation rates increased during the middle of twentieth century. Beginning in the 1940s more young people attended and completed high school, which meant they had more options for employment than their peers of a previous generation. In 1940 72 percent of sixteen and seventeen year old Iowans enrolled in school while 28 percent of eighteen and nineteen year olds enrolled.

ed., *Historical Social Research* 29 (3) 2004: 124-149. The author is grateful to Dr. Uekotter for calling this article to his attention.

⁸ Wartime labor shortages were acute in the Midwest, with the states of Iowa, Kansas, Missouri, Minnesota, Nebraska, and North and South Dakota averaging a loss of 27 percent of hired workers from 1939 to 1945. Rural depopulation did not slow down after the war, with both farm operators and hired men either supplementing farm work with city employment or leaving farming altogether. Walter W. Wilcox, *The Farmer in the Second World War* (Ames: Iowa State College Press, 1947), 100. For Iowa wartime shortages, see the *Forty-Sixth Annual Iowa Year Book of Agriculture* (Des Moines: State of Iowa, 1945), 15-16; and Paul J. Jehlik, "Iowa Farmers Using Less Hired Help," *Iowa Farm Science*, 6 (June 1952). For an example of the commentary characteristic of the postwar years see John D. Hervey, "A Kingdom for a Hired Hand," *Successful Farming*, March 1946. Wages are discussed in Paul R. Robbins, "Labor Situations Facing the Producer," in David G. Topel, ed., *The Pork Industry: Problems and Progress* (Ames: The Iowa State University Press, 1968). Donald Holley's study of the role the mechanical cotton picker and African-American migration played in shaping the South is a good example of how labor shortages and associated increases in wage rates helped convince farmers to use machines. *The Second Great Emancipation: The Mechanical Cotton Picker, Black Migration, and How They Shaped the Modern South* (Fayetteville: The University of Arkansas Press, 2000).

By 1960, 86 percent of the former group and 48 percent of the latter enrolled in school. Farm boys who expected to farm upon graduation from high school often did so, but a minority of them did not. Thanks to the G.I Bill, many veterans from farms could afford to attend college, which contributed to the drain of laborers from the countryside. For workers who stayed, farm wages increased, too. With fewer workers, farmers who employed hired hands had no choice but to pay more for labor. While the rate of wage increase in the Corn Belt was not as fast as it was in the South, the real value of wages for farm workers increased by 20 percent from 1950 to 1970.⁹

Compounding the problem of rising labor costs was the cost-price squeeze. From the mid 1950s to the 1960s the costs farmers incurred increased faster than the prices they received for commodities. This situation was especially difficult for farmers from 1951 to 1956. During those years, commodity prices dropped almost 23 percent while non-farm prices remained constant. An Iowa State College study indicated that average farm income declined from \$10,247 in 1953 to \$7,051 in 1955. As historian Gilbert Fite observed, the cost-price squeeze compelled many families to leave their farms, but it also helped those who were in a solid financial position with little debt to increase their landholdings or invest in their farms to gain economies of scale and to cut labor costs.¹⁰

⁹ For the aspirations and realities of high school boys, see "What happens to rural high school graduates?," *Wallaces' Farmer and Iowa Homestead*, 16 February 1957. *U.S. Census of Population: 1960. Volume I, Characteristics of the Population Part 17, Iowa* (Washington, D.C.: U.S. Government Printing Office, 1963), 173. Bruce L. Gardner, *American Agriculture in the Twentieth Century: How It Flourished and What It Cost* (Cambridge: Harvard University Press, 2002), 172-174.

¹⁰ Gilbert C. Fite, *American Farmers: The New Minority* (Bloomington: Indiana University Press, 1981), 107. For the consolidation wrought by the cost-price squeeze, see pages 118-119. A good example of the kind of coverage the cost price squeeze received in the farm press is Dick Albrecht, "What's happening to farm income?," *Wallaces' Farmer*, 2 January 1960. *Wallaces Farmer* changed names several times during the study period, from *Wallaces' Farmer and Iowa Homestead* to *Wallaces' Farmer* and finally to *Wallaces Farmer*. I will use the latter citation throughout the following chapters.

The setting for this story of agricultural change is the heart of the Corn Belt, the region where corn and livestock feeding has been the distinguishing feature of the countryside. Iowa in particular is an important study area because it has been a leading corn and livestock producing state for most of the twentieth century, and in the last fifty years emerged as a leading soybean producing state. As Gilbert Fite and Ladd Haystead observed, with more than half of the total crop acres devoted to corn in the late 1940s, Iowa's percentage of corn acres surpassed that of any other Midwestern state. Iowa farmers accounted for almost 11 percent of the total value of livestock and livestock products sold in the United States in 1950. Covering approximately 56,000 square miles in ninety-nine counties that span the Missouri and Mississippi watersheds, Iowa includes some of the most productive farm land in the world, especially for raising corn. For most of the twentieth century, mixed farms of diverse crops and livestock have been predominant in all parts of the state, although there have been some regional specialties. In the glaciated north and central parts of the state farmers relied on cash grain production and livestock feeding, with some farmers raising other crops such as flax and sugar beets. The south and west have been excellent grazing country, while the northeast has been an important dairy region. Eastern Iowa farms specialized in grain production and livestock feeding. In spite of the differences, most farms in the state were more similar than different before World War II, with production by section of the state varying by degree more than in kind.¹¹

¹¹ For a survey of the growth and development of the Corn Belt see John C. Hudson, *Making the Corn Belt: A Geographical History of Middle-Western Agriculture* (Bloomington and Indianapolis: Indiana University Press, 1994). Ladd Haystead and Gilbert C. Fite, *The Agricultural Regions of the United States* (Norman: University of Oklahoma Press, 1955), 144, 149. In chapter seven, Haystead and Fite focus on the characteristics of farming in the corn-soy producing states of Illinois, Indiana, Iowa, Missouri, and Ohio.

There are two parts to this study, breaking down complicated and interrelated technological changes into discrete elements. Part one addresses the rise in use of chemical insecticide, herbicide, fertilizer, and feed additives such as antibiotics and growth hormones. Iowa farmers were on new ground with chemical farming. Only a small minority of farmers used chemical fertilizers before the war, and the new pesticides as well as synthetic antibiotics and growth hormones were products of wartime research and development programs. As a result, farmers climbed a steep learning curve with chemicals, using them and misusing them in combination with traditional cultural practices to control weeds and insects, while replacing animal manure with chemical fertilizer. Farmers who used this “package” of chemical technology realized tremendous productive gains in both crop and livestock production. They lived with many unanticipated consequences of their decisions to employ chemicals, including the proliferation of resistant species of plants and insects, and growing questioning from the public and government officials about the health and safety implications of farm chemicals.

Part two shows how farmers used new mechanical technology to assist with the harvest of grain, soybeans, and corn, as well as the architecture of grain storage and automated materials handling. Farmers had a great deal of experience with machines, which allowed them to make a smooth transition to tractor-drawn and self-propelled harvest implements. Cost savings, the benefits of reducing dependence on hired labor, and gaining time to change work cycles or for leisure were critical benefits farmers perceived in using new machines. While some machines such as tractor-drawn combines and hay balers helped farmers reduce labor costs, other machines such as combines for corn and the buildings and crop dryers needed to store shelled corn rather than ear corn were some of the most

expensive items farmers would ever purchase. Self-propelled combines and fully automated feeding systems were the tools of a minority of farmers as the 1970s began, but that minority was growing quickly.

Each chapter covers the same time period, a repetitive strategy but one that offers excellent perspective. By discussing each technology on its own, readers will see the similarities and differences between farm practices and the trajectories of farm technology usage. Some changes were slow while others were rapid. Some practices raised environmental concerns among farmers and outsiders, others did not. By breaking up technological change into pieces, it is possible to see how farmers used each technique to reshape the landscape. Taken together as two parts and a complete project it is possible to see how each technological innovation complemented the others. In this sense, readers can understand the “bundle” or “package” of technology that farmers used to adjust to changing times and the ways in which farmers changed their times.

The technological changes discussed in the following pages show that farmers directed much of that transformation. Farmers, simultaneously producers and consumers, decided what particular techniques would help them make a living on their farms. While advertisers, extension experts, bankers, and policy makers certainly had a voice in how farmers conducted their business, farm families were the ones who allocated resources to invest in new technology and lived with both anticipated and unanticipated consequences of that use. The choices farmers made about technology forever changed the physical and social landscape of the Corn Belt. Labor-saving machinery and chemicals, new crop rotations, new weed and insect species, and new structures and machines on the farmstead remade the land. This productive revolution also forced the issue of who would stay in

farming. A sizable minority of farmers on the 205,399 farms in Iowa in 1945 either would not or could not continue to farm in the next twenty-five years. The cost of purchasing or hiring all the new equipment as well as the increasingly expensive and complicated chemical package was too great or too daunting for many farm families. By 1970 there were only 135,264 farms in Iowa.¹²

This study is not a comprehensive account of all the technological changes on Iowa farms during the years of this study. Tracing every new development in Corn Belt agriculture would be a valuable undertaking, but that is far beyond the scope of this project. Many developments such as artificial insemination, changes in genetics and breeding standards, and larger, more powerful, and complicated tractors became common after World War II. These changes and more were important, but await future study. The mechanical and chemical changes depicted in the following pages tell a great deal about the ways farmers used technology and why they did so. *Industrializing the Corn Belt* is a chapter in the history of Midwestern agricultural production, not the final word.¹³

¹² Rural sociologists at Iowa State College explored the ways farmers adopted new technology at the time it occurred. Sociologists argued that there were stages of technological adoption and that the farm population could be segmented into categories based on the sequence that they adopted new farm practices. This project is informed by the work of the sociologists but the purpose is different. Rather than analyze the farm population to determine who was first, last and in between, the argument here is that farmers themselves were leaders in remaking the landscape. See "How Farm People Accept New Ideas," Iowa State College, Ames, Iowa, *Special Report No. 15*, 1955; Joe M. Bohlen, "Adoption and Diffusion of Ideas in Agriculture," in *Our Changing Rural Society*, ed. James Copp (Ames, Iowa: Iowa State University Press, 1964); George M. Beal and Everett M. Rogers, "The Adoption of Two Farm Practices in a Central Iowa Community," Agricultural and Home Economics Experiment Station, Iowa State University, Ames, Iowa, *Special Report No. 26*, June 1960. Historian Mark R. Finlay observed that not all farmers adopted a "Fordist" approach to agriculture in his study of postwar hog production. See "Hogs, Antibiotics, and the Industrial Environments of Postwar Agriculture," in Susan R. Schrepfer and Philip Scranton, eds., *Industrializing Organisms: Introducing Evolutionary History* (New York and London: Routledge, 2004). *Forty-Sixth Annual Iowa Year Book of Agriculture, 1945* (Des Moines: State of Iowa, 1945), 737; *Tenth Biennial Report of Iowa Year Book of Agriculture, 1970-1971* (Des Moines: State of Iowa, 1972), 344.

¹³ Sam Bowers Hilliard emphasized changes in tractor power and the trend toward self-propelled machinery in his excellent overview of mechanical change in American agriculture written at the end of the period under

It is worth noting a few other topics and perspectives that fall outside of the scope of this work. Public policy is not a major focus, even though important elements of public policy were essential to some of the technological changes discussed here, including wartime policy changes to support prices and the ensuing debate of the 1940s, 50s, and 60s over price supports. Conservation policy and techniques were also significant during this period, but they are not central to the story. Policy makers, agriculture experts, and many farmers promoted or practiced soil conservation to varying degrees in an effort to save soil for future generations and to remove land from production to help support commodity prices. Farmers' attempts to preserve or change policy through lobbying groups or protest organizations deserve future study but are only mentioned in passing here. Visions of alternative or sustainable agriculture are beyond the scope of this study. Readers will better understand mainstream agriculture, not the fringes. Gender and sex roles are not central themes of the study, either, although most of the voices in the study are male. Women and men shared much of the work described in the following chapters, but much of the evidence for this work comes from men. This does not mean that men were the only farmers in the family or that this account is only a story of what happened to men. The labor of women, men, and children was still vital to many of the farm operations described in this study and their work and perspectives are recognized where it helps advance the story of technological adoption and adaptation.¹⁴

examination in this study. See "The Dynamics of Power: Recent Trends in Mechanization on the American Farm" *Technology and Culture* 13 (January 1972): 1-24.

¹⁴ Studies that address other important changes of the postwar period include: R. Douglas Hurt, *Problems of Plenty: The American Farmer in the Twentieth Century* (Chicago: Ivan R. Dee, 2002); Willard W. Cochrane and Mary E. Ryan, *American Farm Policy, 1948-1973* (Minneapolis: University of Minnesota Press, 1981); Allen J. Matusow, *Farm Policies and Politics of the Truman Years* (Cambridge: Harvard University Press, 1967); Edward L. Schapsmeier and Frederick H. Schapsmeier, "Eisenhower and Ezra Taft Benson: Farm Policy

To tell the story of technology from the user's perspective means including evidence from the users. Several types of sources help bring farmers' voices to the forefront. Each chapter of the dissertation is under-girded by a thorough examination of *Wallaces' Farmer and Iowa Homestead*, a farm publication specifically targeted to Iowa farmers. *Wallaces' Farmer* is important because Iowa farmers were the intended readers and because the writers and editors also used the experiences of Iowans, including ample quotations from actual farmers and experts. At a more interpretive level, the editors let readers see different sides to most stories. They were not afraid to cover technology that did not work out as planned or to show debates among farmers or experts about which kind of farm family or operation might or might not benefit from new technology. Other farm publications have been valuable, including *Successful Farming*, *Farm Implement News*, and *Agricultural Engineering*, but the intended audiences for these publications were either nationwide or highly specialized. Furthermore, these other publications did not include as much testimony from farmers.

Several types of agricultural extension records have also been central to the story of changes in farm production. The county extension directors' annual reports provide impressions of what happened at the county level. These reports reflect the viewpoints of the

in the 1950s," *Agricultural History* 44 (October 1970): 369-378; James N. Giglio, "New Frontier Agricultural Policy: The Commodity Side, 1961-1963," *Agricultural History* 61 (Summer 1987): 53-70. For the issue of soil conservation, see Philip J. Nelson, "To Hold the Land: Soil Erosion, Agricultural Scientists, and the Development of Conservation Tillage Techniques," *Agricultural History* 71 (Winter 1997): 71-90. Farm organizations of the postwar period deserve more attention from historians. For farm lobbying from a political science perspective, see John Mark Hansen, *Gaining Access: Congress and the Farm Lobby, 1919-1981* (Chicago: The University of Chicago Press, 1991). The National Farmers' Organization was active in Iowa, although it has not been seriously studied by professional historians. See Don Muhm, *The NFO: A Farm Belt Rebel, A History of the National Farmers Organization* (Lone Oak Press, 2000) and George Brandsberg, *The Two Sides in NFO's Battle* (Ames: The Iowa State University Press, 1964). Several key studies devoted to women in farming and rural life have already been cited. For the story of alternative agriculture, see Randal S. Beeman and James A. Pritchard, *A Green and Permanent Land: Ecology and Agriculture in the Twentieth Century* (Lawrence: University Press of Kansas, 2001).

extension staff members rather than the farmers, but it is possible to read between the lines to see what farmers did and what they wanted. The county directors reported what types of information farmers said they wanted. Complaints from county directors indicate that farmers followed the advice of experts sometimes and often kept their own counsel. These reports are less valuable for the period after the mid 1950s. The more recent reports tend to be more about the extension service and less about the farmers, reflecting a change in the organizational culture of extension work. Annual reports from the state entomologist include correspondence, technical reports, photographs, newsletters, and other information that flowed between the Iowa State College/University extension staff, county directors, and farmers. While there was no annual weed specialist report, the papers of the extension weed specialist included much of the same kind of information that the annual reports of the entomologist contained. Extension agricultural engineers corresponded with manufacturers of farm implements as well as users, advising them on best practices. Finally, extension publications show the changing recommendations of the experts to match new research and results from cooperating farmers.¹⁵

Farm record books have also been a good lens for observing the big picture as well as the nuances of agricultural change. By tracking what and when farm families purchased and how much it cost it is possible to see changes in production techniques and farm financing. These records also potentially obscure change, too, since only a small number of farm records represent a large number of farmers in the state, but they do confirm some of the

¹⁵ Dorothy Schwieder, *75 Years of Service: Cooperative Extension in Iowa* (Ames: Iowa State University Press, 1993) is an excellent account of state extension activities from this period, including the role that Extension staff members performed in spreading the news about new technology. For a history of the extension service, see Wayne D. Rasmussen, *Taking the University to the People: Seventy-Five Years of Cooperative Extension* (Ames: Iowa State University Press, 1989).

major trends in Iowa agriculture as well as the role individual farmers played in technological change.¹⁶

Oral histories provide some insight into farm production. Farmers offered a wealth of information about what worked for them and what did not. They explained why using a corn picker made more sense to some farmers than using a combine and why it was often economically more feasible to hire a hay baler than to purchase one. The technological adaptations and modifications to equipment made by farmers with mechanical expertise provided some of the earliest inspiration for this study and suggested the central role farmers played in leading technological change in the American heartland.

Industrializing the Corn Belt is a study of farm life through the eyes of farm people in an important area within the Corn Belt. It is an attempt to understand farmers' diverse view points as they used technology to make a living, simultaneously remaking the social and physical landscape. Few farmers either adopted every technological innovation or rejected every innovation. Most of them, including those who left agriculture, used some techniques and passed on others. They made their own choices. The conclusion that farmers were leaders in the process of agricultural change in the postwar period is not a denial that other parties were important actors in technological change. Extension professionals, advertisers, journalists, and bankers all played important roles in advising farmers on how to meet their needs. They advised, counseled, and even pleaded with farmers to change their behavior on various occasions, but these outsiders could not make decisions for farmers. Farm families used new technology in ways that they believed would best meet their needs during a time of

¹⁶ I have been careful to acknowledge when farm record books either confirm or contradict the general pattern of farm decision making, purchasing, and production. These record books are still coming in to archives at the time of writing. Over the course of this project, several new collections have become available.

tremendous change in the countryside, urban places, and in the relationships between urban and rural Americans.

CHAPTER ONE

Insecticide: War on Bugs

In 1943 Iowa farm journalists stood up and took notice of a new crop pest, the European corn borer, declaring “Borer Racing Across Iowa.” The European corn borer crossed the Mississippi River from Illinois the previous year without attracting much attention, although it plagued farmers in states of the eastern Corn Belt for years. First introduced into the United States in the early 1900s, most likely as stowaways in broomcorn imported from either Hungary or Italy into Massachusetts, European corn borers entered Ohio in the 1920s and migrated across Indiana and into Illinois in the 1930s. Borer moths laid eggs on corn leaves in May, and when the worms hatched they began eating the leaves before boring into the stalks where they transformed into pupae. In August those pupae emerged as moths and laid their eggs on corn leaves, but this time the second brood lived in the stalks all winter before emerging the following May, repeating the cycle. Depending on the degree of infestation, these insects prevented ears from developing on the corn plant or even caused them to drop to the ground before harvest. Sometimes the stalk damage was so severe that the developing corn plants blew down in strong winds. By 1943, corn borers had spread all the way into the central counties of the state, causing significant losses in the corn crop.¹

During the war years extension experts and farm journalists prescribed the same cultural control treatments for corn borers that they invariably prescribed for almost all insect pests; chopping corn stalks after harvest, plowing under all remaining stalk material, making fodder or silage out of green corn, and delaying planting to avoid the worst part of the

¹ “Borer Racing Across Iowa,” *Wallaces Farmer*, 21 August 1943.

infestation. All of these tactics interdicted the life cycle of the insect, denying it a place to spend the winter and reducing the threat for the next year. But in 1946 Iowa farmers began using a new tool to check corn borers as well as other insects that attacked livestock and plants. Dichloro-diphenyl-trichloroethane, commonly known as DDT, had been developed as an insecticide by the Geigy Company in Switzerland in 1939 and used effectively and with great publicity during World War II. The United States Army used DDT to check a typhus epidemic in Naples in 1943 by killing the lice which carried the typhus. In 1945, Iowa State College Extension staff worked with county agents and farmers across the state to demonstrate the efficacy of DDT on agricultural pests, inaugurating a new era of chemical insect control in Iowa agriculture.

Between 1945 and 1970, farmers used insecticides to supplement and even replace cultural techniques to obtain important reductions in insect populations. However, farmers used these new chemicals on their own terms, experiencing varying degrees of success in manipulating their environment. By 1950, farmers faced two challenges to their independent chemical strategy. They discovered that some pests developed resistance to insecticide or naturally tolerated it. Insects that survived treatment could produce offspring that resisted the chemicals. Government researchers also reported that residues of insecticides could be found in dairy and meat products from treated animals. Farmers turned to new chemicals to solve these problems while facing more stringent federal regulations to avoid passing poisons on to people. Ultimately, farmers relied on chemical control as their first line of defense for some pests but not for others, using chemicals when it could help them maximize their investment. As the 1970s began, farmers could no longer use DDT and some of the chlorinated

hydrocarbon insecticides they had relied on, since the USDA, FDA, and state of Iowa banned them due to health concerns, but they had a new array of chemicals at their disposal.²

The story of chemical insecticide demonstrates the relationship between farmers and technology. Farmers used the chemicals to meet their needs, accepting parts of the pest control message and rejecting others. Chemical insecticide became common before 1972, but there were important distinctions between the types of infestation, chemicals used, and even the type of farmers who used insecticide. While Iowa farmers began to treat their crops and livestock for dozens of insect pests in the years after World War II, this chapter focuses on three of the most widespread and commonly treated pests. Treatment for corn borers with DDT peaked around 1950 before fading during the 1950s, giving way to the use of improved corn borer resistant hybrids. By contrast, an increasing number of farmers used DDT and other chemicals for fly control. By 1972 livestock producers, especially dairy farmers, universally used chemical fly control. Treatment for soil insects such as rootworms with insecticides increased dramatically over the course of the 1950s and 1960s, outpacing the use of chemicals for corn borer control. Iowa farmers frequently defied the directions from manufacturers and experts on how to use chemicals, responding to some parts of the chemical control message and not others. When chemical manufacturers advised farmers

² Many historians have treated the story of DDT and insecticides, although seldom from the viewpoint of the users. For a recent and comprehensive account of the insecticide story see Edmund Russell, *War and Nature: Fighting Humans and Insects from World War I to Silent Spring* (Cambridge: Cambridge University Press, 2001). Pete Daniel's *Lost Revolutions: The South in the 1950s* (Chapel Hill: University of North Carolina Press, 2000) is the most extensive treatment of how farmers used insecticides and the effects of that use on animals, insects, and people. Thomas Dunlap demonstrated how DDT came to be perceived as a public health threat and the role of the federal government in regulating it in *DDT: Scientists, Citizens and Public Policy* (Princeton: Princeton University Press, 1981). For a recent study of chemical warfare in rural America, see Joshua Blu Buhs, *The Fire Ant Wars: Nature, Science, and Public Policy in Twentieth Century America* (Chicago: The University of Chicago Press, 2004). Two useful scientific overviews of the history and action of insecticides as well as herbicides include F. L. McEwen and G. R. Stepenson, *The Use and Significance of Pesticides in the Environment* (New York: John Wiley & Sons, 1979) and G. T. Brooks *Chlorinated Insecticides, Volume I, Technology and Application* (Cleveland: CRC Press, 1974).

that “It’s time for action!” when “pests attack your pocketbook,” farmers acted, but in their own ways and in their own time.³

There were few options to stop the European corn borers that threatened farmers’ crops at the height of World War II. Some farmers took the advice of extension staff and farm journalists to plow under corn stalks and use other control techniques to break the borers’ life cycle, but they did not stop the spread of these insects. Estimates of crop losses due to corn borer infestations in the 1943 crop year were as high as 4 percent of the corn crop from Indiana to Eastern Iowa. Extension staff members characterized the corn borer as “the biggest [insect] problem facing Iowa farmers” in 1945, noting that estimated yield losses that year amounted to 6 million dollars contrasted with just 2.5 million in 1944. Each year the corn borer continued to spread westward, so that by 1948 corn borers had been recorded in every county in the state.⁴

At the urging of the Iowa State College Extension Entomologist Harold “Tiny” Gunderson, farmers experimented with DDT for corn borer control in 1946. Experiments

³ Ronald Kline has shown how rural consumers adopted and adapted technology to meet their particular needs, often rejecting the goals of manufacturers, reformers, and government officials. Ronald Kline, *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore and London: The Johns Hopkins University Press, 2000). Standard 25% DDT Concentrate Advertisement, *Wallaces Farmer*, 7 June 1952.

⁴ “Borer Racing Across Iowa,” *Wallaces Farmer*, 21 August 1943; “Corn Borer Damage Over 4 Per Cent,” *Wallaces Farmer*, 14 April 1944; *Annual Report, Entomology, 1945*, Summary, 3. The *Annual Report for Entomology*, later titled *Annual Report for Entomology and Wildlife*, is one of the most valuable sources used in the preparation of this manuscript and deserves some explanation. These yearly reports include a wide variety of information, including summaries of work performed by the Iowa State College (later University) Extension Entomologists, project reports, correspondence to and from the state entomologists, memos to county agents, technical reports of chemical and cultural control experiments from cooperating farmers, radio and television scripts and program outlines, texts of talks given to youth groups, surveys of insecticide use, photographs, programs from training meetings and conferences, newspaper clippings, and recommendations for insecticide use. Only a few years of these reports have consistent page numbers throughout the entire bound volume; most of them are not organized as a unit. In citing information from this diverse and invaluable source, the author has provided as much specific information about the particular evidence from within the volume. All of the reports will be cited as *Annual Report, Entomology*, accompanied by other identifying information and the year of the report. The collection is located at Special Collections, Parks Library, Iowa State University and listed as: Records, Cooperative Extension Service, Entomology and Wildlife.

with sweet corn growers showed between 90 to 100 percent control of corn borers in treated fields. Farmers read about a test at Kankakee, Illinois, where 85 percent of the pests were destroyed by dusting plants, resulting in yield increases of up to 25 percent. A writer for *Wallaces' Farmer* noted that "It may be some time before the average farmer can use this method of combating borers," since the cost, estimated at \$15 dollars per acre, was much more than farmers could afford. It was not long before chemicals for corn borer control became an affordable reality, as Iowa farmers saw a flurry of print materials from extension and advertisers promoting the economics of killing corn borers.⁵

Outreach through pest control meetings, speaking engagements, radio spots, and later television programs were also important techniques for informing farmers about corn borers and control techniques. In 1945 extension entomologists drafted a script for a talk on corn borer control for use at 4-H club meetings that stressed cultural control techniques of deep, clean plowing of cornstalks before May 15, planting late, and using hybrids with strong stalks and ear shanks. Harold Gunderson distributed a skit written by extension drama specialist Pearl Converse to each county extension director for use at township level meetings in March, 1947. The skit highlighted both cultural and chemical control methods, using humor to get the message to the people.⁶

Extension experts stressed a balance of cultural and chemical control but DDT was most appealing part of the pest control message. Farmers listened to clean plowing talks and attended demonstrations to learn what they could do to stop the borers. In 1946 the state entomologist and the agricultural engineers collaborated to sponsor seventeen clean plowing

⁵ *Annual Report, Entomology, 1946*, Summary, 1; "Kill Borers With DDT Dust," *Wallaces Farmer*, 1 September 1945.

⁶ "Corn Borer Control, Discussion for 4-H Club Meetings," *Annual Report, Entomology, 1945*; Harold Gunderson To County Extension Directors, 18 February 1947, *Annual Report, Entomology, 1947*.

demonstrations in eight counties. However, the state entomologist concluded that “DDT appears to be the best single weapon now available against the corn borer.” He cited instances of farmers who used DDT to gain higher yields in fields that were free of corn borers. A cooperative venture with the Pioneer Hybred Company on a farm in Durant yielded twenty to twenty-eight bushels per acre more in DDT treated fields than in untreated fields. These were significant gains when the average yield per acre was approximately fifty-five bushels. Without denying the value of cultural techniques, Gunderson and others made no such claims for their effectiveness, indirectly encouraging farmers to rely on chemicals.⁷

In 1948 state extension mounted a determined, sustained campaign to promote DDT for corn borer control. In February, Gunderson articulated four points in the borer control program, which included purchasing resistant hybrids, early planting, and clean plowing but, as in 1947, his main emphasis was on DDT. Gunderson stated that every dollar spent on DDT would return five to ten dollars to the farmer through yield gains. An article titled “Use DDT To Kill Corn Borers” included information on cultural techniques, but, reflecting Gunderson’s optimism about DDT, emphasized that chemical treatments would make delayed planting unnecessary. Claiming that “Old Ways Failed to Stop Corn Borers,” the editors of *Wallaces’ Farmer* advised farmers to “use every method” to control the population of corn borers, but then systematically showed the weaknesses of each cultural technique, concluding that spraying with DDT was “about the only corn borer control method that the individual farmer can be fairly sure of.” In November, a USDA and Iowa State College survey reported that a record number of corn borers would be wintering in Iowa. Observers predicted that more farmers would use DDT in 1949, since farmers and entomologists “are

⁷ J. G. Gunning, “Plow to Kill the Borer,” *Successful Farming*, March 1946; *Annual Report, 1946*, 1-2.

pinning most of their hopes in the corn borer battle on chemical treatment.” These optimistic reports about DDT in the farm press overshadowed the attention given to cultural techniques.⁸

Farmers applied DDT to first and second brood borers or sometimes both to kill pests and obtain substantial yield increases. Suggested treatment per acre in 1950 was one and a half pounds of DDT per acre, per application. It could be applied as dust or as a spray, depending on the equipment at hand. The important point about application was to get the chemical on the leaves and in the whorl of the plant, the place where the leaf emerged from the stalk, since this was the place where the larvae penetrated the plant. Many farmers made or purchased sprayers in the late 1940s to spray insecticide and herbicide. While there were many custom applicators in the late 1940s, many farmers believed it was a good idea to do their own work, as indicated by the remarkable increase in sprayers on Iowa farms from 5,000 in 1947 to almost 42,000 in 1950. There were complaints about unskilled or crooked fly-by-night custom sprayers who moved through rural neighborhoods promising to spray DDT. These scam artists or incompetents applied improperly mixed chemicals or substituted some other spray, using “the magic name of DDT to fleece farmers.” But these isolated complaints of fraud did not discourage many Iowa farmers from using DDT to see the results for themselves.⁹

⁸ “DDT Reduces Borer Loss,” *Wallaces Farmer*, 21 February 1948; “Use DDT To Kill Corn Borers,” *Wallaces Farmer*, 7 February 1948; “Old Ways Failed to Stop Corn Borers,” *Wallaces Farmer*, 17 April 1948; “Keep Fighting Borers,” *Wallaces Farmer*, 20 November 1948. O. T. Zimmerman and Irvin Lavine, *DDT: Killer of Killers* (Dover, NH: Industrial Research Service, 1946), is a good example of the kind of promotional material of the late 1940s. Also see Russell, *War and Nature*, chapters eight and nine.

⁹ “Stop Corn Borer Damage!,” By Harold Gunderson, Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 134*, May 1948; “Controlling The European Corn Borer,” Agricultural Extension Service, Iowa State College, Ames Iowa, *Pamphlet 150*, December 1949; Harold Gunderson and E. P. Sylwester, “Spraying---Babyhood to Manhood in 5 Years,” E. P. Sylwester papers, Special Collections, Parks

Farmers who tried DDT were generally pleased with it, especially when they had a chance to see side by side comparisons of treated and untreated corn. John Ostercamp of Hancock County followed the advice of his county extension director in 1949 and performed a double test, leaving unsprayed check strips in the corn he treated and a few sprayed rows in the corn he did not treat. He found that in his unsprayed sections the corn yielded seventy-eight bushels per acre, while his sprayed sections yielded over eighty-five bushels per acre. A Kossuth County farmer obtained as much as fifteen bushels to the acre more corn on his sprayed acres.¹⁰

Chemical treatment for European corn borers had a rapid rise. In 1947, farmers only treated about 50,000 acres of Iowa corn with DDT. The next year, they treated approximately 167,000 acres, while in 1950 and 1951, farmers treated almost approximately 1.735 million acres, representing approximately 15 percent of 11 million acres of corn in the state. This increase was due to the hype surrounding DDT, the seriousness of the corn borer infestation, and the ability of the extension system to get the message out about the threat of corn borers. The state entomologist collected reports of corn borer egg masses in fields from across the state, mobilizing 4-H boys to gather data for the first time in 1944. The boys made corn borer counts and reported damage caused by the borers. These estimated counts allowed entomologists to predict the extent of infestations for both broods of borers. In theory, statewide estimates permitted farmers to know if they were at risk for either mid

Library, Iowa State University; "Sprayer Market in '50 Looks Good," *Farm Implement News*, 10 February 1950; Farm Radio Service, 11 August 1947, *Annual Report, Entomology, 1947*.

¹⁰ Wally Inman, "Ready For The Borers?," *Wallaces Farmer*, 3 June 1950.

season second brood borers or if they needed to plan for a heavy infestation from the first brood in the following year.¹¹

DDT use for corn borer control declined just as rapidly as it rose. By the 1960s, farmers only treated a handful of acres with occasional jumps in use depending on the degree of infestation. One significant reason for declining corn borer treatments was the relative difficulty in actually observing the insects. Unless farmers were diligent about looking for infestations it was difficult to know if corn borers were a problem. Corn borer egg masses on the leaves are no larger than a quarter of an inch long, while the borers themselves are thinner than a pencil lead and approximately one-sixteenth of an inch in length, making them difficult to see. Farmers who found corn borers also had to work to determine the extent of infestation. Extension experts argued that the population had to cross a threshold to make treatment worthwhile. To discover an infestation, farmers conducted a random sample of a field. They walked into the field a specified distance, counted egg masses on one plant, turned ninety degree and walked another specified distance and then counted egg masses again. During the late 1940s and early 1950s, experts recommended spraying if the population exceeded fifty egg masses per 100 plants.¹²

¹¹ Yearly statistics for the estimated use of chemicals for fly, European corn borer, and corn rootworms are from the Entomologist's *Annual Report* summaries. The figure for total corn acreage is from 1949. *Agricultural Statistics, 1950*, USDA, (Washington, D.C.: U. S. Government Printing Office, 1950), 46. At least three versions of a corn borer control pamphlet were in circulation before 1970. See "The European Corn Borer and its Control in the North Central States," Cooperative Extension Service and Agricultural and Home Economics Experiment Station, Iowa State University, Ames Iowa, *Pamphlet 176* (Revised), October 1961; and the revised version October, 1968.

¹² USDA researchers worked on other methods of control for the European corn borer, including the release of 154,000 wasp-like parasites in fourteen Iowa counties in 1944, attempting to replicate earlier success with other insects in California. Those efforts are not included in this study, since they were undertaken by institutions and not by farmers. Populations of predator species such as the four-spotted fungus beetle increased at the same time as the corn borer. The general story of biological insect control efforts in the years up to 1951 is covered in Richard C. Sawyer, "Monopolizing the Insect Trade: Biological Control in the USDA, 1888-1951," in *The United States Department of Agriculture in Historical Perspective*, ed. Alan I Marcus and Richard Lowitt (Washington, D.C.: Agricultural History Society, 1991): 271-285. For an overview of the four-spotted fungus

Even if farmers were aware of corn borers in their fields and performed the egg mass counts, they did not necessarily perceive them as a major threat. In early 1946, a panel of farmers at a corn borer conference in Cedar Rapids reported that farmers would not do much to control the insects “until after their pocketbooks have been hurt to the extent of 10 to 15 bushels of corn per acre,” implying that farmers could live with losses from 15 to 20 percent of the crop yield. Similarly, the Benton County extension director observed that “The farmer who only has a moderate infestation does not do too much about them.” As late as 1964, T. A. Brindley, the director of the USDA’s Regional Corn Borer Laboratory in Ankeny, Iowa, echoed this concern, adding that years of good growing weather compounded the problem. “It’s difficult for a farmer who was growing 50-bushel corn 5 years ago and is growing 100-plus bushels now to be concerned about borers,” he observed. Treating for corn borers also coincided with haying season, which made treating for borers a “nuisance” to farmers who wanted to make hay while the sun was shining. The difficulty in understanding the extent of corn borer damage was a serious factor in the limitation of treatment for the borers.¹³

A comparison with chemical weed control (see chapter two) helps make sense of the decision not to spray for corn borers. Farmers with fields infested by weeds could easily see the extent to which weeds were taking over a field even before the weeds were out of control, making the decision to use herbicide an easy one. Unlike European corn borers, Iowa

beetle see C. E. McCoy and Tom A. Brindley, “These four-spotted bugs...Friend or Foe?,” *Iowa Farm Science*, 6 (May 1952): 12-13. In 1959, farmers read about the development of a “living insecticide,” the bacteria *bacillus thuringiensis*, which produces a spore within the larvae of the borer moths that triggers a disease that is lethal to the borer. This *bt* corn became a significant technique for controlling European corn borers in the late twentieth and early twenty-first centuries as scientists developed technology to genetically modify seed plants. “New living insecticide to go on field trials,” *Wallaces Farmer*, 7 February 1959; Keith Remy, “A biological control for the corn borer?,” *Wallaces Farmer*, 7 March 1964.

¹³ European Corn Borer Conference, Cedar Rapids, Iowa, 16-17 January 1946, *Annual Report, Entomology, 1946*; Keith E. Myers to Harold Gunderson, 2 March 1946, *Annual Report, Entomology, 1946*; Keith Remy, “What’s Happened to the corn borer?,” *Wallaces Farmer*, 1 February 1964.

farmers had contended with weeds for generations, making the transition herbicide much easier than the transition to insecticide.

The most important reason for the decline in treating for European corn borer was the development of new hybrids that were either resistant to the insects or tolerated them. This type of biological control was mentioned as early as the mid 1940s, when extension staff members suggested that farmers select hybrids that had strong shanks and stalks that could withstand some degree of infestation. In the 1950s, seed companies responded by breeding hybrids that were specially suited to withstanding the borers. Researchers actually collected borers and harvested egg masses to place in the whorls of the growing parent corn plants. Corn that survived the infestation in good condition became the parent stock of new hybrids. The inbreeding and development of the crosses needed to produce enough hybrid seed to put on the market took time, but seed corn companies offered new and more resistant hybrids each season. Dr. Brindley of the Regional Corn Borer Laboratory argued that the development of “resistant” or “tolerant” hybrids was one of the most important reasons why farmers paid less attention to chemical treatment by the 1960s.¹⁴

Selecting hybrids that could withstand borer infestation was the economical way to fight the insects. Iowa farmers were already committed to buying hybrid seed, with 100 percent of farmers using it by 1942, so there was no new investment needed as long as the variety performed as promised. Using resistant hybrids as a preventative approach was potentially more economical than chemical rescue treatment. In addition to the additional costs, spraying, as noted, could conflict with other pressing tasks such as haying, forcing

¹⁴ Research and breeding efforts are described in a promotional comic book depicting a father and son visit to the Northrup King Research farm at Shakopee, Minnesota. “KX [Kingscrot] Research at Work For You,” KX-57-4, Northrup, King & Company, 1957; Remy, “What’s happened to the corn borer?.”

farmers to neglect other profitable work. Farmers also faced restrictions on feeding DDT treated silage to beef and dairy animals, since ingested DDT was stored in animal fat of beef animals and dairy products. Charles Havran of Benton County never sprayed for corn borers. His son recalled that “The big thing...was buying hybrids that had stronger stalks.” Bob Nymand of Audubon County echoed this, noting that he did not treat his corn for borers in the 1950s and 1960s.¹⁵

Farmers who treated for borers did not necessarily make it a regular practice. Farm record books show that treatment for corn borers was sporadic, not only from year to year, but was seldom a practice people used on their entire acreage. Rudolf Schipull of Wright County sprayed for borers in 1951 and 1954. The first year he only treated twenty-nine acres with aerial application at a cost of \$50.75. In 1954, two years after he retired from active farming, he used DDT again, spending \$186.00, but neglecting to mention how many acres he treated or the method of application. Joseph Ludwig of Winneshiek County purchased 117 gallons of DDT in 1949 for corn borer treatment, the only mention he ever made of purchasing DDT for his crops. William Adams of Fayette County made one purchase of DDT before his record keeping ceased in 1959. He bought eighty-three gallons of DDT in 1950 without indicating how he planned to use it. The experiences of Schipull, Ludwig, and Adams confirm the fact that using chemicals to treat for corn borers was the exception rather than the rule.¹⁶

¹⁵ Fremont, Conrad, “Resistant Corn Checks Borer,” *Successful Farming*, November 1942; Dennis Havran, interview with author, 11 January 2002, Des Moines, tape recording; Bob Nymand, interview with author, 30 October 2002, Brayton, Iowa, tape recording.

¹⁶ Rudolf Schipull papers, Special Collections, Parks Library, Iowa State University; Joseph Ludwig papers, Special Collections, Parks Library, Iowa State University; William Adams papers, Special Collections, Parks Library, Iowa State University.

Results from a 1959 survey of 100 Adair County farmers show the relatively low degree of effort given to chemical control of corn borer after the initial excitement of the late 1940s. Ninety-five farmers participated in the survey, or approximately 5 percent of all the farmers in the county, with seventy-nine farmers reporting that they never treated for corn borers. One person who treated in the 1958 crop year noted that he did so to obtain higher yields, but most farmers who responded explained why they did not use DDT. The most common response was that treating for borers did not “do any good,” with others reporting that the infestation was not bad enough, that they lacked time to do it, or that they believed that it would not solve the problem unless their neighbors treated their fields, too.¹⁷

While the use of insecticide for corn borers decreased in the 1950s, farmers increased their use of DDT and other chemicals for fly control. As early as 1947, experiments indicated that beef cattle would gain weight faster and dairy cows would produce more milk if they were not bothered by flies. Each blood meal that a fly extracted from its host meant less blood supply for the host. Furthermore, animals twitch, swish their tails, and swing their heads to get flies off, all of which require movement and calories that could be used for production. Unlike corn borer infestations, flies were a very visible problem, since dairy farmers were in close proximity to their animals at least twice per day at milking time and beef producers observed cattle at feeding times. Cooperative extension demonstration projects in 1947 showed that dairy cows and beefs treated with DDT produced an average of over three extra pounds of milk production per day and gained a half a pound of body weight more per day than the non-treated animals. While many farmers did not keep the kind of records as the people who cooperated with extension service to conduct experiments,

¹⁷ D. Ivan Johannes to Harold Gunderson, 4 May 1959, *Annual Report, Entomology, 1959*.

they did “watch the milk pail and the cream check” and noticed that after using DDT they saw increases in production in the summer when production traditionally dropped due to fly attacks. Advertisers reinforced the message, claiming that for only a few cents farmers could add up fifty pounds more beef per animal and up to 20 percent more milk with “Pestroy 25% DDT” manufactured by the Sherwin-Williams Company. According to one writer for *Wallaces' Farmer*, “The increased gains or extra milk from fly-free cattle are so valuable you “can’t afford to let flies get started even for a week.” These economic concerns made fly control chemicals an obvious choice for profit-minded farmers, just as planting improved hybrids made more sense than spraying for corn borers.¹⁸

Farmers reported the near miraculous fly killing power of DDT in the mid to late 1940s. Bert Brown, a farmer from Polk County who raised bulls for artificial insemination, was one of the early experimenters with DDT. In 1945 a group of farmers visited his operation with a journalist, who reported that after spraying there were some flies in his barn and that a fly would occasionally land on one of the bulls, “but the animals were not being tormented on a hot August afternoon.” The next year, a dairy farmer from Mitchell County noted that “It works practically 100 per cent in the barn,” while a farmer from Dubuque County reported “very good results from DDT application, both on the buildings and on the cattle.” The relative ease of spraying was also impressive. Farmers who sprayed could simply stand on a fence board of a paddock or corral and use a low pressure sprayer to douse

¹⁸ “Farmers Strong for DDT,” *Wallaces Farmer*, 17 April 1948; *Annual Report, Entomology, 1947*, Summary, p. 9; Pestroy advertisement, *Wallaces Farmer*, 7 June 1947; “New Chemicals Mean Death to Pests,” *Wallaces Farmer*, 7 August 1948.

the animals, in contrast to the older techniques of driving cattle through a dip tank, which was wasteful, messy, and panicked the animals.¹⁹

In 1947 and 1948 civic leaders and Extension professionals campaigned to rid the entire state of flies. Chemical control was an essential part of this campaign, with extension staff making an intense effort to get urban and rural people across Iowa to use DDT. In towns and cities, community leaders coordinated efforts to spray alleys and dumps and even provided residents and small business owners with free or low cost DDT to treat window and door screens, kitchen walls, and food preparation areas to eliminate the flies. They also encouraged farmers to spray their manure piles every two to three weeks to kill the emerging generation of flies. A Story County dairy farmer, F. H. Lodgsdon, claimed that “DDT is one of the greatest discoveries for farmers,” since in 1946 his farm was fly-free all summer long. A farmer from Greene County declared that “a fellow’s foolish if he doesn’t take advantage of DDT to protect his livestock from flies.” Farm sanitation was an important part of the effort, too, with extension staff and journalists goading farmers to remove manure piles every few days and to clean barns and piles quickly and get manure onto fields. Harold Gunderson likened using chemicals alone to being a fighter with one hand tied behind his back. The campaign generated interest the first two years, with as many as 85 to 90 percent of Iowa farmers practicing a complete fly control program. However, it also became apparent after two years of the war on flies that it was impossible to eradicate a species that had a life cycle

¹⁹ “DDT is Slow Poison,” *Wallaces Farmer*, 1 September 1945; “DDT Raises Summer Milk Production,” *Wallaces Farmer*, 3 August 1946.

of several weeks. In 1949, the percentage of farmers who practiced fly control declined to 50 percent, indicating that there were problems with fly control chemicals.²⁰

The widespread use of chlorinated hydrocarbons to control flies created problems that few, if any, farmers anticipated. One of the first problems they observed was that flies developed resistance to DDT. While noting that Iowa farms could be made “fly-free” in 1949, a writer from *Wallaces’ Farmer* asked “about flies being resistant to DDT?” Extension staff confirmed that flies that survived a treatment could reproduce and have offspring that would survive chemical attacks. Farmers who used strictly DDT for the previous two years needed to try other chemicals such as chlordane, benzene hexachloride, or toxaphene. In the early 1950s, the discussion of resistant flies and the new chemicals available to treat them was a regular feature in fly control articles in *Wallaces’ Farmer*.²¹

Another problem with DDT was that there were health risks to animals and humans. As early as 1946, state extension experts cautioned that there were hazards associated with DDT, a fact routinely mentioned by the farm press. In addition to cautioning users that DDT, like any poison, was harmful to people, Harold Gunderson cautioned that oil based sprays should not be used on livestock and that farmers needed to follow directions. These oil based sprays were more readily absorbed through the skin or ducts, which meant that the chemical was getting to the animal, not the insects it was meant to kill. In 1953 extension pest control experts pointed out that DDT was no longer approved for application on dairy cattle or in dairy buildings. By 1960, there was a “general crackdown” on the misuse of farm chemicals by the FDA. Specifically, the FDA was on the lookout for insecticide residues in animal

²⁰ “Declare War on Flies,” *Wallaces Farmer*, 15 March 1947; “Farmers Strong For DDT,” *Wallaces Farmer*, 17 April 1948. *Annual Report, Entomology, 1949*.

²¹ “Iowa Farms Can Be Made Fly-Free,” *Wallaces Farmer*, 7 May 1949.

tissue or products from DDT, dieldrin, aldrin, chlordane, toxaphene, heptachlor, endrin, and methoxychlor, all chlorinated hydrocarbons. FDA representatives would track serious insect infestations, go to that area to find out what insecticides were being used, and conduct tests on products from that area to determine if there was any evidence of chemical residue in excess of the federal limits. The FDA would confiscate butter from creameries where they found any trace of DDT.²²

After the USDA and FDA issued new guidelines restricting the use of DDT on dairy animals, sanitation received renewed emphasis in fly control programs. As early as 1949, writers for *Wallaces' Farmer* noted that while most farmers were familiar with DDT, it should never be used on dairy cows, dairy barns, rooms for separating cream or storing milk. For the next several years, most fly control articles began with a statement stressing the importance of sanitation as the first step in fly control. "Chemicals won't do the job alone," one writer opined, "You have to get rid of fly breeding places. That can mean some extra work." Farmers who failed to clean out barn lots, cattle sheds, and hog pens could not expect any significant success from the use of chemicals. Manure piles that had been growing outside the barn door all winter should be hauled to the field, since these were places where flies reproduced. In response to a letter from a Bremer County farmer about chemical control, the editor noted that the farmer did not mention that "the best fly control measure" was "...sanitation—[the] destruction of places where flies can breed." While chemicals were

²² Two good examples of the warnings about DDT are J. J. Davis, "A Word on DDT," *Successful Farming*, April 1946 and Jim Roe, "The Latest on DDT," *Successful Farming*, June 1946. "Declare War on Flies," *Wallaces Farmer*, 15 March 1947; Earle S. Raun, "Flies on Livestock," Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 200*, May 1953; "FDA to bear down on chemical misuse," *Wallaces Farmer*, 7 May 1960.

an important part of the program, sanitation had to be the first step. Otherwise, fly populations would rebound and continue to plague livestock.²³

The sanitation message was slow to take hold, however, since farmers had such high expectations of chemicals. In 1952, Val Racek of Story County had trouble getting rid of flies around his hog house, even though he had used DDT, chlordane, lindane, and other chlorinated hydrocarbon chemicals to kill flies. On the suggestion of Earl Raun, an extension entomologist at Iowa State College, Racek began to remove manure every three or four days, which brought a significant reduction in the fly population. Racek's impulse to rely on chemicals to completely control flies made sense in the context of the heavy attention experts, journalists, and farmers gave to the killing power of chemicals. Sanitation practices required more work than chemical control, a fact that made chemical control appealing and made the sanitation message so difficult to sell to farmers who had experienced any degree of success with chemicals.²⁴

For all the setbacks of chemical fly control, it was much more popular than chemical corn borer control, especially for farmers who specialized. The extent to which dairy farmers began to rely on chemicals was apparent in a February, 1951 *Wallaces' Farmer* survey of dairy breed association members. Over 90 percent of the respondents reported that they believed it was profitable to use fly spray on dairy cows and barns, even though only three out of four were satisfied with the particular products they used to spray animals and buildings. Most farmers used DDT to spray their cow barns, and 21 percent used DDT to

²³ "Iowa Farms Can Be Made Fly-Free"; "Clean Up to Get Rid of Flies," *Wallaces Farmer*, 15 April 1950; "Get Early Start on Fly Control," *Wallaces Farmer*, 17 March 1951; "No Need to Live with Flies," *Wallaces Farmer*, 3 May 1952; "You Can't Afford To Feed Flies," *Wallaces Farmer*, 20 June 1953; "Does fly control work for you?," *Wallaces Farmer*, 19 June 1954.

²⁴ "You Can't Afford to Feed Flies."

spray their cows, with 32 percent using methoxychlor and 27 percent using lindane, even though DDT and lindane had not been cleared for use directly on dairy cows since 1949. When asked, “Did you ever hear that methoxychlor was the only residual (long-lasting) fly spray that was safe to spray on dairy cows,” only 43 percent of the farmers surveyed responded yes, suggesting that many farmers were unaware of the guidelines for chemical use. It is also possible that farmers failed to appreciate the risks of chemical use. In 1954 a farmer from Taylor County wrote to the editor of a *Wallaces’ Farmer* stating that he had purchased some lindane concentrate labeled not for use on cattle. “But flies were bad,” he stated, “and I sprayed the cows anyway,” asking what harm the spray would do to the cows. This shoot first and ask questions later attitude indicates that farmers wanted the quick and easy way to relieve animals plagued by pests and to get the remarkable gains that chemical promoters promised.²⁵

New products were on the market by the early 1950s to provide a degree of balance in chemical fly control programs, in part to get around real and perceived issues of resistance as well as the problem of chemical residues in dairy and meat products. Methoxychlor, as noted, was approved for direct application on dairy animals until the mid 1950s, when it, too, was restricted for use only on beef cattle and by 1959 only for use on walls and ceilings of livestock shelters. In 1955, manufacturers introduced malathion and diazinon, organophosphate insecticides that experts touted as safe and easy to use chemicals that killed DDT resistant flies. Malathion and diazinon could be used in places that DDT could not, such as dairy barns. It was not, however, approved for use on dairy cows. Farmers had to

²⁵ “Fly Spray Survey,” *Annual Report, Entomology, 1951*; “Sprayed Cows with Lindane,” *Wallaces Farmer*, 17 July 1954.

use methoxychlor on dairy and beef cattle, although they could still use DDT or malathion on beef cattle if they were on pasture. Fly repellants such as pyrethrin were the only chemicals that could be used on dairy cattle by the late 1950s. Gunderson acknowledged that these repellants only lasted about twenty-four hours, but he also stated that “there isn’t anything available now that will do the job safely and last longer under Iowa conditions.” These chemicals gave farmers more flexibility in controlling flies, allowing them to continue chemical fly control which was easier than sanitation and solved the problem of resistance.²⁶

Throughout the 1950s the number of farmers practicing fly control steadily gained momentum after the initial surge of the late 1940s. In 1952 extension entomologists reported that Iowa farmers treated approximately 45 percent of dairy cattle with insecticide for flies. That number steadily increased throughout the decade, with 50 percent in 1954 and 94 percent by 1960, surpassing the previous high levels of 1948. Similarly, the percentage of farmers using insecticide on beef cattle increased from 7 percent in 1952 to 61 percent in 1960. Farmers with beef herds were aided by the development of a back rubber type applicator that farmers could build which allowed cattle to treat themselves. There was a strong economic incentive to continue with fly control on the farm that was lacking for many city residents and business owners. The early messages from experts about the potential of DDT and their own experiences using it to kill flies made a big impression on many farmers.²⁷

²⁶ Earle S. Raun, “Kill flies this summer,” *Successful Farming*, July 1959; *Midwest Farm Handbook*, 5th ed. (Ames: Iowa State University Press, 1960), 308-310; “Insect experts talk it over,” *Wallaces Farmer*, 16 April 1955; “New chemical for FLIES,” *Wallaces Farmer*, 20 March 1954; “Insecticides aid in controlling flies,” *Wallaces Farmer*, 7 June 1958.

²⁷ Extension entomologists provided estimates in each year’s *Annual Report* of the number of farmers using chemicals based on county agent reports. Specific fly control strategies are detailed in “Flies on Livestock,” Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 200*, May 1953.

Farm records show the high level of interest farmers had in chemical fly control. Rudolf Schipull purchased a variety of fly control chemicals in the 1940s and 1950s. He bought his first DDT for spraying cattle and buildings in 1948, an unidentified fly spray in 1950, and bought a few dollars worth of lindane in 1953 and 1954. He bought other fly control products in small quantities in 1955 and spent \$29.41 on five gallons of toxaphene, an unidentified spray, and dry dip in 1958. Joseph Ludwig bought one dollar's worth of DDT in 1947 and purchased a product called Dustone for cattle in 1954, 1955, and 1956. William Adams bought some DDT in 1948 and, as noted earlier, eighty-three gallons of DDT in 1950, although it is unclear how he intended to use it. It is possible to infer what he planned to do with it, however, since he made his DDT purchases on June 23 in 1948 and on June 24 in 1950, which match the dates that he bought other kinds of fly spray in 1951 and 1957. Schipull and Ludwig also typically bought fly control chemicals in late June, although they also made purchases at other times of the year. These three farmers all experimented with DDT before moving on to other products by the end of the 1950s, although it is impossible to know if they quit using DDT because of the messages from experts or for some other reason. Regardless of the chemical they used, these men were all interested in improving fly control by using chemicals.²⁸

Farmers hesitated to give up their tried and proven tactics, especially DDT and other chlorinated hydrocarbon insecticides, even after more than a decade of warnings to about the risks. Although the farm record books show that some farmers modified their chemical use as regulations changed, other farmers did not. In 1960 Harold Gunderson wrote an impassioned and confidential appeal to county extension agents urging them to redouble their

²⁸ Schipull papers; Ludwig papers; Adams papers.

efforts to educate farmers about the proper uses of fly control chemicals. Gunderson was appalled after he examined a survey of Iowa farmers' chemical use which showed that 64 percent of Iowa farmers used restricted residual chemicals on dairy cows that had not been recommended for years. Twenty-three percent used DDT on dairy cows while 33 percent used lindane, chemicals that had not been cleared for use on dairy cattle since 1948. "The worst shock," Gunderson noted, "came when I read that nearly 24% of Iowa dairy farmers were slapping a chemical on their cows whose ingredients they didn't know." Gunderson recognized the gravity of this situation, warning that the FDA could shut down local creameries and dairies that were the sources of poisoned dairy products. The next year the Clinton County extension director reported that many dairy farmers did not know what precautions to take when spraying their cows and did not know which products were approved for use on dairy cattle. In 1965 two farms in Fayette County were quarantined after inspectors found dieldrin residues in milk from those farms. Milk samples from each of the thirty-three cows from those farms tested positive for dieldrin contamination. That year thirteen Iowa dairy farmers had to dump their milk, in one case for 150 days, because of residual insecticides in their milk. The campaign to educate farmers about the merits of chlorinated hydrocarbon insecticide and to promote its use had worked too well. Farmers had adopted these insecticides and used them liberally, achieving good fly control but potentially undermining their own livelihood.²⁹

Efforts to control soil insects such as the corn rootworm resembled the widespread adoption of insecticide for fly control, although chemical treatments for the soil insect

²⁹ "To All County Extension Personnel," *Annual Report, Entomology, 1960*; *Annual Report, County Extension Activities, Clinton County, 1961*, 19 (hereafter cited as *Annual Report*, followed by the county name and page number); *Annual Report, Fayette County, 1965*, 6; Bob Dunaway, "Keep insecticides out of milk," *Wallaces Farmer*, 13 August 1966.

complex did not get underway until the 1950s. The opening phase of the campaign began in 1951, with demonstration plots set up in cooperation between farmers, extension entomologists, and experiment station entomologists in Dubuque, Butler, Wright, and Boone Counties. Cooperators tested five chlorinated hydrocarbon soil insecticides, including aldrin, chlordane, dieldrin, heptachlor, and lindane, showing that farmers could control rootworms and gain up to 13 bushels more corn per acre. The success of these tests encouraged extension staff to set up more demonstration plots in 1952. Manufacturers began to sell fertilizers mixed with insecticide in the mid 1950s, which likely accelerated the rate of adoption, since applying fertilizer and insecticide together reduced the number of trips across the field. In 1959 farmers purchased insecticide granules, which could be applied broadcast or in rows.³⁰

Farmers readily took up soil insecticide for rootworm control. In 1953, twenty-six county extension directors reported that farmers were using soil insecticides before planting 85,433 acres to control soil insects, primarily corn rootworms. Extension professionals encouraged farmers to practice crop rotation to control rootworms, but insecticides were the popular control solution. More farmers used more insecticide to treat for soil pests almost every year of the 1950s, growing from over one million acres in 1954, to almost 2.2 million in 1958 to 5.4 million in 1960. In a survey of farmer attitudes about chemicals published in 1958, 93 percent of farmers indicated that they were satisfied with their soil insecticides. These farmers found that treating for soil insects was relatively easy, since it could be done before planting or at planting time. As one farm journalist stated, “Effective control [of soil

³⁰ *Annual Report, Entomology, 1952*, 16; Scotty Woods, “Now-granules control soil insects,” *Successful Farming*, April 1959.

insects] depends on applying chemicals before damage is done.” Farmers liked the idea of using insecticide on second or third year corn fields which were more vulnerable a build up of soil insects than fields in the first year of the corn rotation. Two Dallas County farmers found that their pre-plant broadcast applications in 1953 helped boost their corn by ten bushels in comparison to their untreated crop. Rudolf Schipull and Joseph Ludwig purchased starter fertilizer with insecticide in the late 1950s and into the 1960s. Schipull began purchasing fertilizer with aldrin in 1959, spending an average of \$92 per year in 1959, 1960, and 1961. From 1965 to 1967 he bought both insecticide fertilizer combinations and soil insecticide, including aldrin and Aldrex, spending an average of \$254 per year. Joseph Ludwig bought \$477 worth of fertilizer with aldrin in 1965 and began to use soil insecticide on a regular basis in 1973.³¹

Soil insecticides, when used with herbicide and chemical fertilizers, spurred a trend toward abandoning traditional crop rotations of corn, oats, and hay during the 1950s. Iowa farmers in the late nineteenth and early twentieth centuries used rotations to keep crop production high, since rotating crops prevented the buildup of soil pathogens, insects and weed populations while incorporating nitrogen fixing plants such as clover to help corn plants. But chemical farming meant that farmers could now manage this balance through chemical treatments, allowing them to grow corn year after year in the same ground. Harold Gunderson urged farmers to not plant corn more than two years in the same field. But his protest indicated that farmers were abandoning rotations that included two years of legumes

³¹ *Annual Report, Entomology, 1953*, 9; J. H. Lilly and Harold Gunderson, “Fighting the Corn Rootworm,” *Iowa Farm Science* 6 (February 1952); “Feed insects or fight ‘em,” *Wallaces Farmer*, 5 March 1955; Bohlen, Beal, and Hobbs, “The Iowa Farmer and Farm Chemicals,” 12; “Get the jump of rootworms!,” *Wallaces Farmer*, 2 April 1955; Schipull papers; Ludwig papers.

or grasses. This environmental shift toward continuous corn cultivation resulted in changes in the insect populations, especially resistance in soil insects.³²

Iowa farmers faced a resistance problem beginning in 1961. That year the western corn rootworm, a species resistant to chlorinated hydrocarbons, entered Iowa from Nebraska. Unlike the northern corn rootworm, the dominant rootworm species, the western corn rootworm was resistant to the chlorinated hydrocarbon insecticides such as aldrin, dieldrin, or heptachlor. The western corn rootworm was a minority in 1962, comprising an estimated 10 percent of the total rootworm population. As a result, extension experts did not recommend a change in chemical tactics, urging farmers to continue using aldrin and heptachlor, applied at different rates depending on whether the farmer only treated the row or broadcast the insecticide across the entire field. For row treatment, experts recommended applying both insecticides at the rate of one half pound per acre, while the rate for broadcast treatment was two pounds per acre for first year corn and only one pound for land in continuous corn, presumably because there was some carryover effect from the first year. By 1963, however, the problem had grown from “only four or five fields” in western Iowa to a third or more of the state. Even the northern corn rootworm, a pest that had been controlled by aldrin and heptachlor, was also developing resistance by 1963. In 1966 resistant corn rootworms were present in all Iowa counties. Farmers now faced another resistance problem, much like the one they confronted in fly control during the 1950s.³³

³² Harold Gunderson and J. H. Lilly, “Control Corn Rootworms,” Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 178* (Revised), April 1953.

³³ “Rootworm control for 1962,” *Wallaces Farmer*, 7 April 1962; “Proceedings—Corn Rootworm Conference,” *Annual Report, Entomology, 1963*; “Resistant corn rootworms now in all Iowa counties,” *Wallaces Farmer*, 5 February 1966.

A new and more expensive family of insecticides, the organophosphates, was the solution to the problem of resistance. Diazinon and Thimet, two organophosphate chemicals, were the new killers to handle the resistant rootworms. Farmers learned about the spread of resistant insects in late 1963, when Harold Gunderson announced that the western corn rootworm had been present in most of western half of Iowa, with “severe problems” in the western third of the state. Jeff O’Hara of Page County expressed his interest in the new chemicals in 1964. “I’m going to use an organo-phosphate at planting time on all my corn, first year as well as second year,” adding, “I don’t think I can afford to take the risk [of not using it].” An advertisement for the American Cyanamid Company featured fear a scare tactic strategy. Farmer Neal Van Beek of Sioux Center, shown pictured with a bag of Thimet 10-G, stated, “We can’t expect a crop in 1965 unless we rely on THIMET.” Gunderson advised that there were several alternatives for rootworm control including rotation, although a 1964 article in *Wallaces Farmer* only included chemical options as realistic choices. Using aldrin and heptachlor was the least expensive choice, costing approximately \$1.50 per acre. The new chemicals, diazinon and thimet, cost approximately \$2 to \$3 per acre. Farmers could justify this extra expense if they lived in the higher risk western part of the state or if their chlorinated hydrocarbon treatment failed in 1963.³⁴

The new chemicals were more toxic than the chlorinated hydrocarbons, requiring special handling procedures and inspiring regulation. While handling DDT and other insecticides was dangerous, years of experience showed that most farmers were not at

³⁴ “It pays to control soil insects,” *Wallaces Farmer*, 6 April 1963; “Control Recommendations For Corn Rootworm Announced, Iowa State University Information Service, For Release Saturday, November 9, 1963,” *Annual Report, Entomology, 1963*; American Cyanamid Company advertisement, *Wallaces Farmer*, 6 February 1965; Ken Hofmeyer, “What farmers plan to do for corn rootworms,” *Wallaces Farmer*, 18 April 1964; Keith Remy, “Ways to control soil insects in your 1964 cornfields,” *Wallaces Farmer*, 21 March 1964; Lloyd E. Zeman, “How to Cope with New Corn Rootworm Problems,” *Successful Farming*, January 1964.

immediate risk from incidental exposure to chlorinated hydrocarbons. They faced bigger risks in the long term, since chlorinated hydrocarbons were stored in fat cells and continued to build up over the years. By contrast, exposure to organophosphate insecticides could kill a person almost immediately. They are nerve agents which inhibit the proper functioning of nerves, preventing the body from transmitting nerve impulses to vital organs.

Over the next few years, insecticide safety became a much more prominent feature of the coverage of farm chemicals, in part because of some serious incidents involving animals and people. At the beginning of the 1965 planting season, Harold Gunderson reported that a farmer had been poisoned while he was applying organophosphate chemicals in a tailwind. The farmer's symptoms included constricted pupils, severe internal cramps, excessive respiratory tract secretion, headache, and weakness before he began to recover. From 1967 through 1970 there was one reported case of livestock poisoning every two weeks, although not all of the incidents could be blamed on the farmers. One Iowa farmer accidentally killed thirty-six steers when he fed his animals feed from an elevator that contained corncobs contaminated with aldrin. When the worker at the elevator loaded the cobs, he accidentally broke some nearby bags of the chemical and it became mixed in with the cobs. Urging farmers to "Play it safe with rootworm chemicals," farm journalists and extension safety experts prescribed a long list of safety procedures, including wearing a respirator, covering skin completely with clothing, wearing goggles, frequent bathing and washing of clothes, and making sure to only apply when there was not wind. A study of pesticide accidents from the late 1960s indicated that almost three fourths of accidents resulted from three causes; failure

to follow directions, improper storage, and chemicals placed in improperly marked containers.³⁵

In spite of educational attempts by extension staff and farm journalists, people were still confused about the new safety equipment. Gunderson confessed that even he did not understand what kind of equipment should be used, notifying extension cooperators of these problems at the beginning of the 1964 planting season. He claimed that “no one seems to understand the difference between an effective dust respirator with a plain filter...and a true chemical respirator” that was necessary for use with organophosphate insecticides. Farmers and custom applicators that purchased the dust respirators needed to “TAKE THEM BACK!” he urged. The dust respirators merely captured the insecticide particles in the mask, forcing the wearer to breath vapors continuously, which “may be even more hazardous than no respirator at all,” while the respirator inactivated chemical vapors. The costs of this confusion were severe, since farmers, agribusiness, and the university extension system were all under closer scrutiny after the 1962 publication of Rachel Carson’s *Silent Spring*.³⁶

The Iowa Pesticide Act of 1964 was the first major fallout of the post-*Silent Spring* years, referred to by one Iowa State extension expert as the After Carson, or AC era. The Pesticide Act, written in consultation with extension entomologists, became law on January 1, 1964. Provisions of the law included a requirement that all pesticides sold in Iowa be registered with the secretary of agriculture and state licensing for everyone who performed custom pesticide application. The state pesticide lab conducted testing on pesticides as well

³⁵ “Insect Information Letter No. 5, 17 May 1965,” *Annual Report, Entomology, 1965*; Ron Lutz, “Careless pesticide handling causing livestock death losses,” *Wallaces Farmer*, 14 March 1970; Ken Hofmeyer, “Play it safe with rootworm chemicals,” *Wallaces Farmer*, 27 April 1968; “Protect yourself from chemicals,” *Wallaces Farmer*, 26 April 1969; Monte Sesker, “Use chemicals safely!,” *Wallaces Farmer*, 11 April 1970; “Pesticide accidents,” *Wallaces Farmer*, 13 January 1968.

³⁶ “Insect Information Letter #4, 4 May 1964,” *Annual Report, Entomology, 1964*.

as agricultural products to determine residue levels. The pesticide act was relatively lenient, since it did not require any training or regulation for farmers who applied their own chemicals, but it was recognition that some degree of oversight of farm chemicals was necessary, if for no other reason than to quiet public concerns about the impact of pesticide use. For most Iowa farmers it was business as usual, since they were not required to get special training to use chemicals.³⁷

A plurality of Iowa farmers favored a more stringent policy of licensure in 1971. When asked how they felt about only allowing licensed operators to apply chemicals that persistent chemicals such as most insecticides, 42 percent indicated that they would favor such a measure. Thirty-eight percent opposed a licensure requirement, while 20 percent claimed to be undecided on the issue, indicating that farmers were divided over the issue of safety. Younger men, those with some college education, and women reported more support for more stringent pesticide rules. A Poweshiek County woman wanted “someone other than my husband responsible for putting on pesticides. I worry every time he uses it.” Other farmers reported a fear of greater government involvement in farming, while some were pragmatic. One older farmer stated, “I’m afraid the bugs and weeds would take over. How do you get licensed applicators out to do the job when it ought to be done?” Many farmers recognized that there were hazards associated with chemical use, but the issue of government regulation divided Iowa farmers.³⁸

As farmers considered the possibility of regulation, the issue of insecticide residue in Iowa’s surface and groundwater gained attention. Over the course of the 1960s stream and

³⁷ “Pesticide Residue Discussion,” 2 November 1965, *Annual Report, Entomology, 1965; Seventh Biennial Report of Iowa Book of Agriculture, 1964-1965* (Des Moines: State of Iowa, 1966), 71-72.

³⁸ “License applicators of persistent pesticides,” *Wallaces Farmer*, 11 September 1971.

well monitoring conducted by Iowa Water Pollution Commission indicated that pesticides were present in Iowa's surface and ground waters. From 1966 to 1969 several private wells tested positive for the soil insecticides aldrin and dieldrin as well as the herbicides atrazine, 2,4-D, and treflan. Water on the Mississippi, Missouri, Raccoon, Cedar, and Iowa Rivers in 1968 showed that chlorinated hydrocarbon insecticides such as dieldrin and DDT were present at various times through the year. Problems with insecticides in Iowa and the rest of the United States focused attention on the issue and made it an issue for everyone, not just farmers.³⁹

In 1970, just twenty-five years after the most widely used chlorinated hydrocarbon insecticide was first used on fields and livestock in Iowa, the federal and state governments banned the use of DDT. In early 1970 the USDA cancelled the registration of DDT, in effect prohibiting its use. That year the Iowa state legislature formed the Chemical Technology Review Board, a group dedicated to coordinating information about agricultural chemicals among all state agencies. The Board included members of state agencies, representatives of the chemical industry and one farmer, but the advisory committee was responsible for making recommendations to the board for approval. Advisory committee members included representatives from state commissions, Iowa State University faculty, a doctor of veterinary medicine, a medical doctor, and two ecologists appointed by the presidents of the University of Iowa and Iowa State University. At an organizational meeting in July, the board considered, among other topics, the role of chlorinated hydrocarbon insecticides in agriculture. Later that year, the committee recommended that the state secretary of

³⁹ Robert L. Morris and Lauren G. Johnson, "Pollution Problems in Iowa," in *Water Resources of Iowa*, ed. Paul J. Horick (Iowa City: University Printing Service, 1970), 98, 100, 107.

agriculture develop regulations to ban the use of heptachlor, DDT, DDD, as well as lindane vaporizers in the state, except to control pests menacing public health or to carry out state and federal quarantines. Federal and state regulation was not a new feature to farm chemical use, but the complete ban on a chemical put farmers who continued to use one of the most important chemicals they had employed since the end of World War II on the wrong side of the law. The experts who had generated the hype about DDT, then urged caution as farmers used the chemicals in ways they wanted to use them rather than ways in which they were proscribed, now had the force of law.⁴⁰

In the years up to 1972 Iowa farmers had been leaders in shaping the use of chemicals for insect control. While extension experts, manufacturers, and farm journalists promoted chemical control as a solution to various insect problems on the farm, the farmers themselves gave some of the most valuable testimony about the ways in which chemicals could be useful for increasing profits. For corn borers, farmers determined that mid-season rescue applications were not the best way for farmers to use their time or money, especially since they could use a preventative approach by selecting resistant hybrids. Still, farmers used more chemicals on more pests throughout the period. For fly control, farmers climbed a steep learning curve, with important challenges such as resistance and regulation emerging along the way. They continued to use the chemicals they believed would do the job, regardless of the advice from entomologists, manufacturers, and journalists and government restrictions. In the case of soil insecticides, the ability to apply the chemicals either before planting or at the same time as planting made it an efficient use of the farmer's time and money. Farmers made decisions about using chemicals based on local conditions and their

⁴⁰ *Tenth Biennial Report of Iowa Book of Agriculture, 1970-1971* (Des Moines: State of Iowa, 1972), 81-83

perceptions of their needs, not necessarily based on the advice and guidelines they received from other sources.

In 1972 those days were passing. The 1964 Iowa Pesticide Act that provided for licensing of commercial applicators required at least a degree of specialized training and expertise. The extreme and immediate hazard from the new organophosphate chemicals was different from the chlorinated hydrocarbons. Farmers who exercised routine caution with the latter could expect to be around the next year, while those who failed to use the specialized respirators and protective clothing while using organophosphates risked dying in their fields. As historian Thomas Dunlap has shown, the outright ban on DDT was based on its residual effects, not immediate ones. This new, long term approach to risk assessment of chemical use, coupled with the immediate danger of applying chemicals, meant that farmers were likely to face more regulation in the future. Furthermore, there was new pressure from consumers, environmental activists, and government officials for tighter control of chemicals. As Harold Gunderson observed, the Environmental Protection Agency could become a focal point for pressure groups to attack farmers. In his view, most of the critics of chemical policy were “ignorant.” The ban on DDT and the regulatory mission of the EPA marked an important turning point in the relationship Iowa farmers had developed with chemical technology. The use of insecticides by Iowa farmers in the postwar period showed that farmers not only used new technology to solve their problems, but they played a leading role in determining how they used it.⁴¹

⁴¹ Charlie Nettles, “More Confusion Over Pesticides,” *Des Moines Sunday Register*, 29 November 1970. Gunderson’s resentment toward non-experts can be attributed to the breakdown in the consensus over scientific authority Alan Marcus detailed in his study of diethylstilbestrol, *Cancer From Beef: DES, Federal Food Regulation, and Consumer Confidence* (Baltimore: The Johns Hopkins University Press, 1994).

CHAPTER TWO

Herbicide: War on Weeds

Father Time: Why you young villain---you young whipper snapper. I'll mow you down, so help me—I'll mow you down.

Weedy The Thief: Save your breath, Grampa. I'll fill your fence rows and your lawns and your parks and your golf courses with my Weedy Family. Wait and see.

Miss Verda Land: Father Time—do something.

Weedy The Thief: “Do something,” she says!! Do something!! I've got you just where I want you. We'll rob your soil and kill your grass and choke your gardens. We'll fill the world with weeds—weeds victorious!!!! Nothing can stop us.

The Hero 2,4-D: (Bounds in) I can stop you.

2,4-D Skit By Pearl E. Converse and E. P. Sylwester, ca. 1945-1947¹

The new weed-killing chemical, 2,4-D (2,4-dichlorophenoxyacetic acid), had been on the market for less than a year when Iowa State College extension botanist E. P. “Dutch” Sylwester collaborated with extension drama specialist Pearl Converse to write this informational and promotional melodrama. The story began as an old and tired Father Time, armed with a scythe, tried to defend Miss Verda Land, dressed in green and carrying a basket representing fertility. The enemy, Weedy The Thief, threatened to dominate Verda Land until The Hero 2,4-D arrived and destroyed Weedy with his knapsack-type sprayer. The skit concluded with a marriage between Verda Land and The Hero 2,4-D, signaling a union between landscape and chemicals in postwar America and confirming the optimism Americans shared about the potential of technology to solve problems.

¹ Dr. Bob Hartzler, Iowa State University Extension Weed Management Specialist, found a copy of the skit in some files in his office and posted it on his website, although the link is no longer present. Although the script is undated, it is probable that Pearl Converse wrote it between 1945 and 1947, since 2,4-D was released commercially in 1945 and Converse died on 4 May 1947. *Ames Daily Tribune*, 5 May 1947.

While herbicides were not new, this one was different. It was a synthetic hormone, called a growth regulator, which mimicked the plant's own hormones present in the growing tips of plants above and below ground. By stimulating growth, the herbicide caused the plant to literally grow itself to death. Unlike older herbicides that killed everything they touched, growth regulators were selective. They killed targeted weed species and did not damage crop plants. Weeds competed with crop plants for moisture, soil nutrients, and sunlight. Farmers who were careless about controlling weeds had smaller crops at harvest time than their more vigilant neighbors. Farmers across the United States recognized the potential use this kind of weed control technique.²

From 1945 to 1970 and beyond, herbicide manufacturers and advertisers promised remarkable weed control for farmers who purchased their products. Advertisements suggested the possibility of weed-free farms, an unheard of notion as long as farmers relied on cultural weed control techniques. These cultural techniques varied by crop in the Midwest, but typically included planting seed that had been cleaned of weed seeds, spring and fall plowing to bury weeds, regular cultivation during the growing season to check the growth of weeds, and mowing pastures and along fence lines to prevent weeds from

² Few historians have examined stories of growth regulator herbicides, and even fewer have studied the ways in which people who used herbicide in pastures, fencerows, ditches, and fields. Most recently, Nicolas Rasmussen has provided an excellent review of the way in which phenoxy acids came to be seen as herbicides. See "Plant Hormones in War and Peace: Science, Industry, and Government in the Development of Herbicides in 1940s America," *Isis* 92 (June 2001): 291-316. Gale Peterson's "The Discovery and Development of 2,4-D," *Agricultural History* 41 (July 1967): 243-253 is also a valuable overview. Pete Daniel offered the most extensive treatment of the use of herbicide in *Lost Revolutions*, chapter four. Many historians of agriculture and rural life have noted the importance of herbicide to postwar agriculture, including Hurt, "Ohio Agriculture Since World War II"; Jack Temple Kirby, *Rural Worlds Lost: The American South, 1920-1960* (Baton Rouge: Louisiana State University Press, 1987); Gilbert Fite, *Cotton Fields No More: Southern Agriculture, 1865-1980* (Lexington: University of Kentucky Press, 1984), 180-187; John T. Schlebecker, *Whereby We Thrive: A History of American Farming, 1607-1972* (Ames: Iowa State University Press, 1975), 271; and Donald Winters, "Agriculture in the Post World War II South" in *The Rural South Since World War II*, ed. R. Douglas Hurt (Baton Rouge: Louisiana State University Press, 1998).

spreading. Cultural weed control was time consuming, however. Iowa farmers spent many hours on tractors and even horses cultivating their corn crops, mowing fence lines and ditches, and even chopping weeds by hand. Most of this work occurred at a time when farmers were pressed by other work such as making hay or silage, putting farmers in a position of having to choose which jobs would get done first, if at all. Chemical manufacturers offered a product that would relieve farmers of the tedious and time consuming tasks of cultural weed control techniques.³

But it was farmers, not manufacturers, who gave herbicide its prominence. In Iowa, farmers eagerly purchased growth regulator herbicide in the postwar years, enticed by the prospect of weed-free farms. Rather than passively accepting manufacturers' specifications and extension service guidelines, farmers made herbicide their own. They did this by determining how much to apply and how often to apply it, as well as by relying on herbicides at the expense of cultural techniques. Yet for all the success farmers experienced in using growth regulator herbicides to suppress weed populations, there were unanticipated consequences. The miracle product 2,4-D did not control all weeds, most notably grassy weeds such as giant foxtail and quackgrass. As Iowa farmers controlled broad leaf weeds,

³ Frieda Knobloch observed that the division between useful plants and weeds is a cultural distinction and not one inherent in pre-human environments. In this sense, agriculture created weeds by giving certain species an opportunity to thrive that they did not previously have. See *The Culture of Wilderness: Agriculture as Colonization in the American West* (Chapel Hill: University of North Carolina Press, 1996), chapter four. The commercial introduction of 2,4-D occurred during a period of optimism about technology. This concept is developed in Alan I Marcus and Howard P. Segal, *Technology in America: A Brief History* (San Diego: Harcourt Brace Jovanovich, Publishers, 1989), chapter seven; and also in Edmund Russell, *War and Nature*, chapter nine. An excellent example of faith in chemical technology for solving pest problems can be seen in Joshua Blu Buhs, "The Fire Ant Wars." There are several excellent contributions to the history of technology in postwar agribusiness, although historians tend to focus on the institutional and scientific contexts for technology rather than the perspectives of the consumers of technology. Notable examples include Sheldon Krimsky and Roger P. Wrubel, *Agricultural Biotechnology and the Environment: Science, Policy, and Social Issues* (Urbana: University of Illinois Press, 1996); and Jack Ralph Kloppenberg, jr., *First the Seed: The Political Economy of Plant Biotechnology, 1492-2000* (Cambridge: Cambridge University Press, 1988). Thomas Dunlap not only studied the debate over DDT use, but he also discussed the ways in which interest groups responded to the issue of pesticides before and after World War II. See Dunlap, *DDT: Scientists, Citizens, and Public Policy*.

grassy species proliferated, compelling farmers to use new and more expensive herbicides, sometimes even mixing them or applying herbicide in the soil. By 1970, farmers used a new, complicated, and expensive weed control strategy, although their farms were not free from weeds. The mixed performance record of growth regulator herbicides did not compel farmers to lose faith in their chemical strategy. Just like the generations that preceded them, Iowa farmers engaged in an annual struggle to keep ahead of weeds, using herbicide in record quantities and on record acreages.

In 1945, three chemical companies, Dow Chemical, Sherwin-Williams, and the American Chemical Paint Company began to sell 2,4-D. Fruit growers used growth regulators in the 1930s to stimulate growth to promote uniform ripening of some fruits, but their use in deliberate lethal doses did not come until 1941 under the direction of E. J. Kraus of the University of Chicago. The United States government experimented with 2,4-D as a tool for biological warfare throughout World War II. Although the war ended before 2,4-D could be used for military purposes, promoters believed it could play an important part in agriculture.⁴

At the end of World War II, farmers, extension professionals, journalists, and county supervisors from across Iowa argued that the weed problem was worse than it had been before the war. Weeds that cut yields or were toxic to livestock caused farmers to lose money, but controlling weed populations was labor intensive work. Citing wartime labor

⁴ Rasmussen "Plant Hormones in War and Peace," 309-311. See also Peterson, "The Discovery and Development of 2,4-D," 244-247; Orvin C. Burnside, "The History of 2,4-D and Its Impact on Development of the Discipline of Weed Science in the United States," in Orvin C. Burnside, ed., *Biologic and Economic Assessment of Benefits from Use of Phenoxy Herbicides in the United States*, Special NAPIAP Report Number 1-PA-96, November 1996, 5-11; L. W. Kephart, "Weed Control With Chemicals," *Agricultural Engineering*, November 1946, 506-511; John W. Mitchell, "Plant Growth Regulators," in *Science in Farming: The Yearbook of Agriculture, 1943-1947* (Washington D.C.: U. S. Government Printing Office, 1947): 256-266; "Trying New Kind of Weed-Killer," *Wallaces Farmer*, 3 March 1945; "New Weed Sprays," *Wallaces Farmer*, 17 November 1945.

shortages and the burden of increased production goals, county officials and farm journalists highlighted how “Weeds Won in War Years,” as a writer for *Wallaces’ Farmer* wrote in early 1947. County extension directors reported on the deterioration of Iowa farms. While farmers attacked weeds in fields, they were lax in controlling weeds in fencerows and ditches, which allowed weeds to propagate and proliferate. The Hamilton County director reported that due to manpower shortages, “we have many farms now that are fairly well covered with noxious weeds that were fairly clean a few years ago.” In Humboldt County Canada thistle was a particular problem, gaining a presence on as much as 95 percent of farms there. When Bert and Vesta Sams moved from Clarke County to Marshall County in 1946, they purchased a farm that had been neglected for years and was choked with weeds. Clifford Sams, who was twenty-five at the time and had just returned from military service in late 1945, recalled that “This place was so infested with weeds of every kind; burdock, sourdock, Canada thistle. It really took a lot of serious work to get control of it.” Not all farmers, however, were as aggressive about weed control as Bert Sams, and the state legislature passed a stringent new noxious weed law in 1947.⁵

Legislators hoped the 1947 noxious weed law would pressure farmers to control neglected weeds in fields, fencerows, and roadside ditches, thereby saving the state’s farmers millions of dollars in lost profits due to weed infestations. Declaring war on weeds, lawmakers allowed county commissioners to levy taxes to pay for a weed control employee as well as equipment, and materials. County commissioners could notify farm owners or tenants of a weed problem and give them five days to cut or spray the noxious weeds. If

⁵ “Weeds Won in War Years,” *Wallaces Farmer*, 18 January 1947; *Annual Report, Hamilton County, 1946*, 7; *Annual Report, Humboldt County, 1945*, 10; Clifford Sams, interview by author, 13 September 2002, Conrad, Iowa, tape recording.

farmers did not handle the problem, the county “weed man” could come out and do it, charging owners for costs plus a penalty fee of 25 percent of costs. Similarly, farmers with property adjacent to county roads had to cut ordinary weeds within thirty days of notification or suffer the same penalty. Over a year later farmers reported that the weed law was helping to control the problem, but all the farmers surveyed in a *Wallaces’ Farmer* poll noted that lax or spotty enforcement compromised the effectiveness of the law. Some commissioners reported progress in the fight against weeds in 1949, claiming that education and gentle pressure were effective tools in getting cooperation.⁶

State and county extension staff members were active in spreading the news about weed control techniques, promoting 2,4-D as well as cultural weed control practices to reduce their threat. Extension botanist Dutch Sylwester and extension pest control specialist Harold “Tiny” Gunderson conducted weed and pest clinics for groups of a few dozen to over two hundred farmers around the state throughout the winter months. From the fall of 1947 through the following autumn, Sylwester conducted 193 meetings with estimated attendance at approximately 133,000 people. At the 1945 Humboldt County Fair Sylwester assisted with a special weed day where farmers could examine a demonstration plot to see the effectiveness of chemical weed killers. During the growing season, Iowa State College hosted field tests at different locations around the state. County extension directors also played a vital role in promoting the use of herbicide by setting up demonstration plots, hosting Sylwester for weed meetings, and answering questions from area farmers about herbicide. The Kanawha Experimental Farm in Hancock County was open for touring on 6

⁶ “Weed Law Has Teeth,” *Wallaces Farmer*, 7 June 1947; “New Law Helping in Weed Control,” *Wallaces Farmer*, 6 November 1948; “Winning Weed Fight,” *Wallaces Farmer*, 18 June 1949.

July 1948 for farmers to see “what happens to weeds when 2,4-D and other weed killers are used in crops.” Implement dealers displayed various types of weed control tools, reflecting the integrated cultural and chemical weed control approach that extension staff favored.⁷

Extension staff members continued to stress the importance of cultural techniques for weed control even as they advocated the use of chemical herbicide. During the 1940s and 1950s state and county extension staff emphasized the value of chemical control for the problem weed patch or the wet year when cultivation was difficult, but they did not advocate chemical control as a panacea. Extension experts believed that chemicals were the “ace in the hole,” not a replacement for cultural techniques. *Wallaces' Farmer* writers echoed the experts, noting, “Chemical weed killers are vital to efficient weed control. But they are not a substitute for a number of good farming practices.” Sylwester argued that planting clean, weed free seed for oats and pastures was a “cornerstone” of good weed control. Practicing proper rotation, good seed bed preparation, cultivating, and mowing weeds in pastures and fence lines were regular admonitions in the farm press and in the talks Dutch Sylwester gave across Iowa. Furthermore, experts noted that many plant species such as grasses were resistant to 2,4-D and could be best controlled through cultivation.⁸

⁷ *Annual Report, Humboldt County, 1945*, 10; *Annual Report, Hardin County, 1945*, 6; Annual Report Summary-Weed Control, October 1, 1947-September 30, 1948, E. P. Sylwester Papers, Special Collections, Parks Library, Iowa State University; *Fiftieth Annual Iowa Year Book of Agriculture* (Des Moines, Iowa: State of Iowa, 1949), 451; “Coming Events,” *Wallaces Farmer*, 1 January 1949; “College Sets Field Days,” *Wallaces Farmer*, 19 June 1948; “Four Iowa State College Farm Clinics,” *Wallaces Farmer*, 2 February 1950.

⁸ E. P. Sylwester, A. L. Bakke, and D. W. Staniforth, “Recommendations for Chemical Weed Control,” Agricultural Extension Service, Iowa State College, *Pamphlet 140*, March 1949; “Here’s How to Kill Weeds,” *Wallaces Farmer*, 19 March 1949; “Don’t Plant Weed Seeds in 1950,” *Wallaces Farmer*, 3 March 1950; “Don’t Let Weeds Whip You,” *Wallaces Farmer*, 2 February 1952; “Time Cultivation to Kill Weeds,” *Wallaces Farmer*, 7 June 1952; “Get Corn Weeds With First Cultivation,” *Wallaces Farmer*, 16 May 1953; “Don’t Throw Away Your Cultivator,” *Wallaces Farmer*, 7 May 1960; Gene Neven, interview by author, 12 October 2002, Marshalltown, Iowa, tape recording; “Weeds 2,4-D Will Kill,” *Wallaces Farmer*, 1 January 1949; L. W. Kephart, “2,4-D, New Killer for Weeds,” *Successful Farming*, March 1946.

Extension staff and farm journalists continued to recommend cultivation for weed control in row crops such as corn and soybeans throughout the 1960s. Extension pamphlets on weed control in corn and soybeans began with obligatory statements about the primacy of cultural control. The rotary hoe, a tool with spiked wheels, was the tool of choice for killing grassy weeds in corn that was less than six inches tall. Shallow cultivation was also an important technique. Experts advocated setting cultivator sweeps or shovels as shallow as possible, since cultivating too deep could damage the crop roots. Experts and journalists on the farm beat were consistent and insistent in their message of integrated weed control.⁹

Exciting stories about the success of 2,4-D, however, overshadowed the frequent warnings to balance chemical and cultural practices. Reporting on the trend to use 2,4-D on cornfields in 1949, Jim Roe of *Successful Farming* claimed “practically every man who used 2,4-D thinks it put more corn in his crib.” A 1949 *Wallaces’ Farmer* article titled “Bad News for Weeds” detailed the successful experiences of three Warren County farmers who used 2,4-D in cornfields during the 1948 growing season. Bottomland farmers who regularly dealt with wet conditions found that using herbicide allowed them to catch up to weeds when wet weather delayed cultivation. One farmer reported that some of the Des Moines River bottomland he farmed was so infested with weeds that it was impossible to distinguish the rows. “Three or four days later [after spraying], you could see the rows. Those fields ended up fairly free of weeds. Without spraying,” he added, “it might not have made any corn.” Adolph Erickson of Monona County explained that in 1948 he used 2,4-D on cockleburrs and Canada thistles in his cornfield. In 1949 he sprayed again, claiming “It really gets ‘em. I

⁹ “Weed Control in Corn,” Iowa State University Extension, *Pamphlet 269*, March 1964; “Weed Control in Soybeans,” Iowa State University Extension, *Pamphlet 270*, April 1969; Monte Sesker, “Chemicals and Cultivation Control Weeds in Corn,” *Wallaces Farmer*, 27 May 1967; Monte Sesker, “Stop Those Weeds in Your Cornfield,” *Wallaces Farmer*, 10 May 1969.

sprayed just before the corn got too tall to drive thru [sic], and kept the spray off the corn. Another year or two and I'll have them cleaned up." Optimistic testimonials such as these made compelling reading for farmers who understood the costs of getting rained out of field work and watching weeds overtake their crops.¹⁰

Farmers readily accepted chemicals as part of their weed control system. They grew up using scythes in their fence rows, enduring weed infested stands of flax and oats that cut yields, slowed the harvest, and forced them to cultivate their corn crop three times each summer at the mercy of the weather. These experiences made them eager converts to new chemical techniques. Furthermore, there were fewer hired men available to do these labor-intensive tasks. In 1949, county directors estimated that approximately 41 percent of Iowa farmers used herbicides. More farmers used herbicide in the northern and western portions of the state where cash-grain and livestock feeding operations dominated. In the extreme northwestern counties usage was as high as 60.1 percent while in the extreme southeastern counties it was as low as 26.7 percent. Farmers tended to use herbicide first on fencerows and roadsides, followed by use on pastures, then corn, oat, wheat and flax fields, in that order. By 1954, more farmers expressed interest in using 2,4-D on cornfields while in 1963 farmers used herbicide in cornfields as often as they did in fencerows and along field borders. The true test of farmers' acceptance of herbicide was the degree to which they believed chemicals helped them increase income. In 1958 half of farmers surveyed believed that chemicals were very important to their income, while 43 percent stated that chemicals were "of some importance." Only 2 percent of farmers in the survey believed that chemicals were

¹⁰ Jim Roe, "We Used 2,4-D On Corn," *Successful Farming*, May 1949; "Bad News for Weeds" *Wallaces Farmer*, 1 January 1949; Wally Inman, "Cheaper Weed Kills," *Wallaces Farmer*, 20 August 1949.

unimportant to their income. Farmers' experiences during the 1950s convinced them that they could benefit from new farm techniques.¹¹

Even farmers who had resisted herbicide use found that it could be beneficial. Bert Sams of Marshall County was a firm believer in cultural weed control practices, but his son Clifford began using herbicide in 1954 after signing a contract to grow seed corn for Pioneer Hi-Bred. The terms of the contract stipulated that Sams use herbicide, linking him to agribusiness in a new way. After the first year of growing for Pioneer, he justified using it because he made higher profits on seed corn than other farmers made for cash grain. Clifford recalled that his father dropped his opposition to herbicide because of the potential profit that could be gained by spraying. According to Clifford, "We felt if everyone else is doing it and you don't you're going to fall behind." Using herbicide did not match Bert's traditional perceptions of good farming techniques, but he recognized that good farming also maximized yields and profits as well as the fact that businesses such as Pioneer could help them succeed in farming.¹²

The growing willingness to use herbicide is apparent in the numbers of custom applicators and those who built or purchased sprayers. A 1951 report by Dutch Sylwester and Tiny Gunderson titled "Spraying—Babyhood to Manhood in 5 Years" emphasized the rapid nature of the change. While there were only eighty-five commercial spray operators in Iowa in 1946, the next year there were 375, with 800 in 1949. That number dropped to 688 in 1950, but the growth in the number of farmers with sprayers suggests that they obtained

¹¹ "Poor Future For Weeds," *Wallaces Farmer*, 3 June 1950; "Farmers Kill Weeds With Chemicals," *Wallaces Farmer*, 5 March 1949; "Kill Corn Weeds With 2,4-D?," *Wallaces Farmer*, 17 April 1954; "Control Iowa's Problem Weeds," *Wallaces Farmer*, 18 May 1963; Joe M. Bohlen, George M. Beal, and Daryl Hobbs, "The Iowa Farmer and Farm Chemicals: Attitudes, Level of Knowledge and Patterns of Use," *Rural Sociology Report No. 3* (Ames: Department of Economics and Sociology, November, 1958), 9.

¹² Clifford Sams interview.

their own sprayers so rapidly that not all of the custom operators could stay in business. Just one year after 2,4-D was on the market 5,000 Iowa farmers owned sprayers, while in 1948 an estimated 22,407 farmers had their own equipment. In 1949 30,000 farmers owned sprayers and in 1950 just under 42,000 farmers could spray their own fields and fencerows. As a 1949 survey indicated, farmers who sprayed tended to purchase their own equipment. In 1948 only 33 percent of farmers who sprayed owned their own sprayers, but 76 percent owned equipment in 1949, with ground equipment such as tractor-mounted or tractor-drawn sprayers accounting for as much as 90 percent of the total.¹³

Although more farmers used 2,4-D and sprayers on Iowa farms, herbicide users found that it did not always control weeds in ways they expected. In 1950 county extension directors reported that 67.3 percent of farmers were satisfied with their spraying and that farmers in most counties would increase the use of the chemical, yet some directors expected a decline in use by as much as 10 percent. In 1954 *Wallaces' Farmer* conducted a poll of Iowa farmers to assess how farmers felt about their chemical weed control efforts. The Wallace-Homestead pollsters asked "If you sprayed the following weeds [buttonweed, cocklebur, and smartweed] in 1954, what kind of results did you get?" Only 3 or 4 percent of farmers reported "no kill" on the listed weeds, between 57 and 65 percent responded that they had "good kill." That left between 32 and 39 percent of farmers who sprayed reporting only "partial kill," a significant minority. In the late 1950s 80 percent of farmers surveyed

¹³ Gunderson and Sylwester, "Spraying—Babyhood to Manhood in 5 Years," E. P. Sylwester Papers; "Sprayer Market in '50 Looks Good."

were satisfied with their chemical weed killer and 71 percent were satisfied with their grass killer.¹⁴

A variety of conditions and circumstances explain the mixed performance record for herbicides and limits of chemical control up through the mid-1950s. Extension directors claimed that the most common problem was operator error. Crop injury such as brittleness in corn occurred when applicators used too high of a rate or sprayed at the wrong crop growth stage. Brittleness was a serious problem because farmers who cultivated could break brittle stalks with their equipment. Regular reports of crop injury due to “too much” chemical, “overdose,” or “too high concentration” came from across the state during the period from 1948 to 1953 when extension directors filed special weed reports. A custom applicator from Illinois advised farmers that weeds in corn fields needed to be sprayed when the corn was between two inches and eight inches tall, although county agents frequently noted that farmers applied 2,4-D at the wrong time. The speed of the tractor, getting too much spray on the corn and not on the weeds, and spray pressure were also frequent problems that could affect the quality of the weed control or even damage the crop.¹⁵

Environmental conditions such as temperature, wind, and rainfall also accounted for mediocre herbicide performance. The Hancock County extension director observed that 2,4-D was not very effective on thistles in 1951 due to cold, wet conditions during spraying. An experiment in Grundy County during the 1957 season illustrates the environmental and human variables farmers struggled with in their efforts to achieve weed control. Extension Botanist Dutch Sylwester recommended spraying 2,4-D in one sixty-acre field that was

¹⁴ “Poor Future For Weeds,” *Wallaces Farmer*, 3 June 1950; “How Does 2,4-D Work For You?,” *Wallaces Farmer*, 18 June 1955; Bohlen, Beal, and Hobbs, “The Iowa Farmer and Farm Chemicals,” 11.

¹⁵ Dana Stewart, “What 10,000 Acres of Weed Spraying Taught Me,” *Successful Farming*, June 1954; *Annual Report, Grundy County, 1948*, “Information on Weed Control Program,” 12.

infested with sunflowers before the farmer planted soybeans. Later that year the extension director reported that one half of the field showed 100 percent weed kill while the other half showed only 40 percent kill. He stated “This suggests that methods of mixing, temperature of the solution, etc. still has a lot to do with the effectiveness of chemicals in controlling weeds.” These considerations could all be present or absent in a given year, making herbicide application a gamble.¹⁶

Furthermore, farmers did not always know what they were seeing when dealing with this new technology, even when it worked. A Hamilton County farmer used 2,4-D on part of his oat field, only to observe that the oats in the portion of the field he sprayed appeared to be damaged by the spray while the part that had not been sprayed was green. The farmer contacted his local extension director, who brought Dutch Sylwester to the farm. When they went into the field, they noted that the green they saw from the edge of the field was actually weeds, not oats. Sylwester concluded that the oats were damaged, but not by the spray. The oat damage was due to blight, although the county extension director noted that the farmer was reluctant to admit it at first. In this case, the experts concluded that the herbicide worked even though it appeared to have failed, but it took expert interpretation to prevent the farmer from blaming the herbicide for his crop failure.¹⁷

While the Hamilton County incident was a case of mistaken identity, other crop failures could be attributed to inherent qualities of the chemical and the ways farmers applied it. Farmers with specialty crops found that spray “drift” from herbicide application could cause unintended damage. In 1952 the assistant manager of the Council Bluffs Grape

¹⁶ *Annual Report, Hancock County, 1952*, 5; *Annual Report, Grundy County, 1957*, 4.

¹⁷ *Annual Report, Hamilton County, 1947*, 6-7.

Growers Association notified Dutch Sylwester that there was “considerable weed spray damage to our grape vineyards,” a fact reflected in the county reports from Pottawatomie County as early as 1950. Growers blamed the railroads. To prevent weeds from spreading across the state along railroad right-of-way, railroad administrators hired aerial sprayers to control weeds that grew in ditches along the tracks, but aerial spraying was especially prone to drifting on air currents beyond target areas. While Sylwester visited Pottawatomie County every year up to 1953, the county director only reported on the problem, with little comment on any proposed solutions aside from urging the railroads to use a formulation of 2,4-D that was less prone to drift.¹⁸

In early 1954 the board of directors of the Council Bluffs growers association, the county extension director and extension weed control and horticulture experts attended a meeting to develop guidelines for minimizing drift. The recommendations included notifying neighbors of grape growers about potential risks, mapping the locations of growers so sprayers working for railroads and power companies could use cultural practices in areas near vineyards, using a formulation of 2,4-D with larger particles that were less likely to drift, and holding meetings to educate people who spray about the potential for damage from drift. There were techniques to reduce drift, such as basal spraying rather than applying the chemical to the foliage, but airplane spraying was indiscriminate and, from the user’s perspective, inexpensive.¹⁹

¹⁸ *Annual Report, West Pottawattamie County, 1950*, 6, “Information on Weed Control Program,” 13; *Annual Report, West Pottawattamie County, 1951*, 8-9, “Information on Weed Control Program,” 12; *Annual Report, West Pottawattamie County, 1952*, 5, “Information on Weed Control Program,” 11; *Annual Report, West Pottawattamie County, 1953*, 4, “Information on Weed Control Program,” 11.

¹⁹ J. Clifford Johnson, interview by author, 14 December, 2002, Council Bluffs, Iowa, tape recording. A. F. Martin to Dr. E. P. Sylwester, 19 September 1952; “Procedures to Help Minimize Danger From Spray ‘Fumes’

In spite of the 1954 meeting and procedures, there is no evidence that these efforts resulted in less drift damage. In 1955 C. E. White of Council Bluffs detailed similar concerns expressed by the grape growers, suggesting the problems had not been resolved. The extension director's report for 1954 recorded the meeting that year but subsequent reports make no mention of any degree of success or failure of the information program. Cecil J. Baxter, a fruit grower from eastern Iowa, also expressed concern to Sylwester, informing him that at least 500 grape vines were killed by drift and many other vines were injured. Baxter noted that weed specialists wholeheartedly endorsed 2,4-D and farmers heeded them, although in truth the issue was more complicated. Extension professionals recommended a balance of spray and cultural techniques, not strictly spray solutions. Farmers frequently did not heed experts and chose to spray rather than practice mechanical control. Baxter did report cooperation he obtained from the Lee County Engineer, who did not allow spraying within three miles of Baxter's vineyard and controlled his sprayers by using the amine form, spraying with low pressure with a larger nozzle to prevent small particles and only spraying when the wind was from the opposite direction. The issue remained contentious into the mid 1960s, when officials in Muscatine, Lee, Mills, Harrison, and the rural portions of Pottawattamie County counties banned the use of the ester form of 2,4-D in 1964. The Iowa Fruit Growers Association called for a statewide ban on this high-volatile form of 2,4-D, arguing that damage in 1964 was as bad as in any previous year. Unfortunately for the fruit growers, the needs of the majority of farmers who raised grain for

and Spray "Drift" in the Council Bluffs Area," Sylwester papers; Fred Slife, "The Most Asked Questions about Basal Spray," *Successful Farming*, February 1954.

sale or for livestock feeding prevailed, and the state legislature, dominated by rural legislators, did not enact a ban.²⁰

There was even evidence that 2,4-D was more toxic to humans and animals than promoters claimed. In the 1940s and 1950s, extension experts and farm journalists urged caution in using herbicides, but they steadfastly maintained that there was little or no risk of injury to livestock or people. Still, they had to remind farmers not to confuse the relatively benign herbicide 2,4-D and the highly toxic insecticide, DDT. The farm press reported on tests where scientists fed 2,4-D and 2,4,5-T directly to animals, applied it to feed and forage, and treated their skin. Scientists concluded that there was no permanent injury to livestock. However, the tests did show that 2,4-D could cause at least temporary harm to both livestock and people. In some cases, the chemical changed the starches in plants to sugars, making some plants that were toxic and distasteful to livestock more appealing but no less toxic. One Audubon County farmer recalled that he was listless and fatigued after a day or two of spraying 2,4-D. In 1962 a railroad switchman from Davenport became soaked with 2,4-D after he walked through treated weeds while working in Illinois. In addition to developing a severe rash, the chemical aggravated the worker's preexisting condition of peripheral neuritis (loss of nerve function in the extremities).²¹

²⁰ Iowa fruit growers were also dealing with other problems that were possibly even more lethal for their business than herbicide. From 1943 until 1964 the Bracero program provided a government subsidized labor force for Pacific Coast growers which allowed them to reduce or hold the line on labor costs. This was a luxury Iowa farmers did not enjoy. C. E. White to H. E. Rea, 6 February 1955, Sylwester Papers, box 9, folder 4; *Annual Report, West Pottawattamie County, 1954, 1955, 1956, 1957*; Cecil J. Baxter to E. P. Sylwester, 10 June 1961, Sylwester papers; Ed Heins, "Urge State Ban on 2,4-D to Save Fruit," *Des Moines Register*, no date, Sylwester papers; Gene Neven interview.

²¹ "Workday Pointers," *Wallaces Farmer*, 1 June 1946; "Workday Pointers," *Wallaces Farmer*, 5 October 1946; "2-4-D Not Harmful to Livestock," *Wallaces Farmer*, 7 June 1947; "Confused on Uses of 2,4-D and DDT," *Wallaces Farmer*, 21 June 1947; "Workday Pointers," *Wallaces Farmer*, 20 August 1949; "2,4-D Kills Weeds, NOT Livestock," *Successful Farming*, June 1959. The authors of a 1996 review of health risks associated with phenoxy herbicides such as 2,4-D concluded that the public is not at risk of any health problems from 2,4-D, but

The uneven performance record of growth regulator herbicide, including evidence of injury to people and livestock, and reports of crop injury did not overshadow the optimism most farmers, journalists, and extension observers shared about its potential. Success stories abounded to offset the reports of failures. In general, the complaints about growth regulator herbicides came from minorities such as the grape growers, horticulturists and an occasional livestock producer. The value of herbicide in the field apparently outweighed the problems such as damage to farm gardens from spray drift. Farmers found that herbicide offered them at least some degree of improved weed control at reduced cost, making the limited risk of injury worth the potential payoff in higher yield.

The low cost of 2,4-D and the equipment to apply it was an important reason why farmers began to use it in the 1940s and 1950s. Aside from the advantages of saving time in cultivating, catching up when bad weather prevented cultivating, and controlling weed infested areas, farmers found that chemicals were inexpensive. In June 1948 Joseph Ludwig of Winneshiek County paid \$49.22 for five gallons of 2,4-D at a local implement dealership. In July he purchased two more gallons for \$19.49 from the same vendor. In 1950, however, he used the same vendor and paid \$4.43 per gallon for eight gallons, with the price varying between \$4 and \$5.50 per gallon over the next few years. William Adams of Fayette paid slightly more for his 2,4-D in the late 1940s and early 1950s, spending \$8.39 per gallon in 1949, \$6.63 in 1952, but only \$3.29 per gallon in 1957. He spent an average of \$68 per year

people who work with the chemical are exposed to potentially harmful doses and should wear protective equipment to minimize risk. See Rebecca A. Johnson and Elizabeth V. Wattenberg, "Risk Assessment of Phenoxy Herbicides: An Overview of the Epidemiology and Toxicology Data" in *Biologic and Economic Assessment of Benefits from Use of Phenoxy Herbicides in the United States*, Orvin C. Burnside, ed., Special NAPIAP Report Number 1-PA-96, November, 1996; "2,4-D Won't Kill Cows," *Wallaces Farmer*, 19 August 1950; Bob Nymand interview; *Holladay v. Chicago, Burlington & Quincy Railroad Company*, 255 F. Supp. 879 (U. S. Dist. 1966).

for herbicide, but this expense only amounted to an average of 5 percent of the total crop expense per year between 1949 and 1958.²²

Sprayers were also relatively inexpensive, especially considering they could be used for insecticides, too. In 1949 advertised costs ranged from \$219 for the Essick tractor mounted model with a fourteen-foot boom to \$230 for the Speedy Sprayer with a thirty-foot boom. Tractor-drawn trailer sprayers were even less expensive. In 1958, Kim's Fast-O-Matic trailer model was advertised at \$208.95 with the Century trailer sprayer at \$186.25. William Adams bought a sprayer in 1949 for \$276.11. Charles Havran of Benton County bought a thirty-gallon drum, pump, nozzles and boom and built a sprayer on his farm. The sprayer Ferd Jarrott of Osceola County built in 1950 cost \$123.41. Many farmers chose to make their own equipment, hoping to cut costs by investing their own labor.²³

Even farmers who purchased sprayers spent very little compared to the cost of other farm implements. When the Iowa State Extension Service published a pamphlet with instructions on making homemade sprayers in 1949, the weed control experts contended "Tractor units can now be bought about as cheaply as they can be made at home." Joseph Ludwig bought a granular herbicide attachment for his planter in 1961 for \$84, while the year before he purchased a sprayer, possibly a used one, for \$70. These items constituted a small part of Ludwig's total investment in machinery and implements. For example, in 1966, the depreciated value of both herbicide tools was \$75 out of a machinery inventory of \$30,680 at year's end. These expenses were nominal for farmers, making equipment cost a non-issue

²² Ludwig papers; Adams papers.

²³ Essick and Speedy Sprayer advertisements, *Wallaces Farmer*, 19 March 1949; Kim's Fast-O-Matic advertisement, *Wallaces Farmer*, 15 March 1958; Century advertisement, *Wallaces Farmer*, 3 May 1958; Adams papers; Dennis Havran interview; Flora and Ferd Jarrott papers, State Historical Society of Iowa, Iowa City.

when deciding whether or not to use chemical weed killers. The degree of weed control was what really mattered to Iowa farmers.²⁴

Farmers and experts who believed in the value of 2,4-D began experimenting with pre-emergent application (applying herbicide after planting but before the crop emerged from the ground) to get a head start on weed control early in the growing season. They endured numerous failures before they could count on pre-emergent application as a reliable method of control. Tests in cornfields in 1948 were generally poor, although tests at the Iowa State College agronomy farm showed that pre-emergent spraying in soybean fields could be successful. In 1950 and 1951 farm writers were more upbeat about the prospects for pre-emergent application, but they were careful not to issue a blanket endorsement, having received mixed reports from the field. Journalist Wally Inman used cautionary language when describing the chances for success of pre-emergent application in 1951. "If you care to spend the money, or are sure the right kind of shower is coming [to insure absorption], you can do a pre-emergence job to be proud of. Otherwise? It's your money!" Heavy rains could wash away the chemical before it had a chance to interact with the weeds, while dry conditions prevented the chemical from being absorbed by the weeds. There were too many variables to make pre-emergent application a reliable practice.²⁵

New products were on the market that promised improved pre-emergent control in the late 1950s and early 1960s. One Humboldt County farmer planted an experimental plot to show the effect of 2,4-D and two new products, Radox and Sinazon, when applied as a pre-

²⁴ "Recommendations for Chemical Weed Control," *Pamphlet 140*, March 1949; Ludwig papers.

²⁵ "Poor Year for 2,4-D Weed Test," *Wallaces Farmer*, 17 July 1948; Wally Inman, "2,4-D Rules for '49," *Wallaces Farmer*, 15 January 1949; "Approve Only Three Bean Varieties," *Wallaces Farmer*, 2 October 1948; "Seedbed Preparation Helps Kill Weeds," *Wallaces Farmer*, 1 April 1950; Wally Inman, "Kill Weeds in '51," *Wallaces Farmer*, 6 January 1951; "Kill Weeds with Pre-Emergence?," *Wallaces Farmer*, 17 March 1953.

emergent. The extension director concluded that there was some improvement in weed control in the sprayed areas, but that the results were “not particularly good.” He concluded that where the seed-bed had been well prepared with harrowing “there was just as much or more weed control as where the proper amount of pre-emergence spray had been applied.” *Wallaces’ Farmer* reported excellent results with pre-emergence weed control in 1960. A 1961 survey indicated that only 3 percent of Iowa farmers used pre-emergent application, but that number increased throughout the 1960s. Reports on the performance of Randox and another new chemical, Atrazine, were generally positive. In 1961 the Audubon County extension director reported that “Atrazine is showing generally good results” as a pre-emergent. Success stories from neighbors and farm journalists encouraged farmers to experiment with this new type of application.²⁶

The experiences of farmers from across the state demonstrate this new trend of minimizing cultivation, even before pre-emergent application was common. In 1951 a farmer from Mills County sprayed corn and followed it with only two cultivations. In 1953 several farmers discussed their modified weed control strategies, emphasizing the importance of herbicide as a labor saving technology. William A. Fridley of Warren County noted “I usually cultivate corn three times. But I want to try one or two cultivations this year—that is, if the weather and weeds will let me.” An Ida County farmer reported that he substituted spraying for one pass of the cultivator through his corn fields. A custom applicator from Illinois shared his experiences with readers of *Successful Farming*. He believed that cultivation had its place, but that a well-timed application of herbicide could save time and

²⁶ *Annual Report, Humboldt County, 1958*, 13; “How Pre-Emergence Herbicides Work,” *Wallaces Farmer*, 1 July 1961; Richard Hagen, “Iowa Farm Report on Pre-Emergence Herbicides,” *Wallaces Farmer*, 1 July 1961.

expense over cultivating. While herbicide had financial costs, pre-emergent spray and granules or post-emergent spray was cheaper than cultivating, since a tractor with a trailer or mounted sprayer used less fuel than a tractor with a cultivator. Operating speeds were higher with a sprayer than a cultivator and the effective width of equipment was greater, saving labor. This degree of flexibility in cultivation would have been unthinkable to farmers before 1945, but it was possible and attractive to a growing number of farmers in the 1950s.²⁷

The shift to less cultivating was disconcerting to some observers, especially experts. Extension directors who preached balancing cultural and chemical techniques were also concerned about an over-reliance on chemicals. They recalled applications that had gone awry and knew that herbicide was not always effective. In 1953 the Clay County extension director recognized the value of weed killers, but feared that “There may also be the other effect of relying to [sic] heavily on chemicals and lowering our diligence in other cultural methods of weed control.” In 1958 Dutch Sylwester, an advocate of an integrated strategy complained “too many folks are expecting chemical weed killers to perform the entire control job.” The Hardin County extension director observed that some farmers were only vigilant about weeds when they could control them easily by spraying. These caveats were rare, however. Sylwester continued to promote weed-killing chemicals and he very likely understood that farmers wanted weed control that would either save them money or time that they could use to devote to other endeavors such as specializing in livestock feeding, dairying, or farming more acres.²⁸

²⁷ “Need Weed-Killing Help?,” *Wallaces Farmer*, 19 May 1951; “Cultivate Corn and Beans,” *Wallaces Farmer*, 6 June 1953; “Cultivate or Spray?,” *Wallaces Farmer*, 19 May 1956; Dana Stewart, “What 10,000 Acres of Spraying Taught Me,” *Successful Farming*, June 1954.

²⁸ *Annual Report, Clay County, 1953*, 4; “Clean Seedbed Will Help Control Weeds,” *Wallaces Farmer*, 3 May 1958; *Annual Report, Hardin County, 1961*, 25.

By 1960 farmers relied on chemicals for weed control, either supplementing cultural practices or replacing one or more cultivations with spraying. But there were significant ecological implications of the proliferating use of and reliance on growth regulator herbicides. The very success farmers enjoyed by using 2,4-D to control broadleaf weeds created an ecological vacuum. Species that coexisted with broadleaf weeds had faced less competition as farmers used 2,4-D to reduce broadleaf populations, allowing species that were tolerant of 2,4-D to thrive. As historians of the environment as well as contemporary observers noted, nature responds to human activity in ways that users of technology do not predict. As early as 1951 observers noticed that a new weed was moving into the Corn Belt. In a *Wallaces' Farmer* report on the discussions at the North Central Weed Control Conference, the author observed that "The threat of grassy weeds to Corn Belt crops is increasing as competition from broadleafed weeds is reduced thru [sic] the use of 2,4-D." The following year the same magazine echoed that fact, noting that giant foxtail was present only in southern Iowa around 1950 but had spread to every section of the state in just a few years. The range for giant foxtail was halfway up the state in Greene County in 1956 and had become a leading weed in Iowa by 1965. Robert Nyman of Audubon County captured the essence of the problem when he stated, "The 2,4-D seemed to feed the grasses." While it was common knowledge that 2,4-D did not control grasses, the rapid advance of grassy weed species surprised most farmers and threatened to undermine the success of chemical control.²⁹

²⁹ Numerous scholars have explored the concept of the ecological vacuum. James A. Young described the invasion of the weed species halogeton in the mountain west in the wake of overgrazing in the early to mid twentieth century. "The Public Response to the Catastrophic Spread of Russian Thistle (1880) and Halogeton (1945)," in *Publicly Sponsored Agricultural Research in the United States: Past, Present and Future*, David B. Danbom, ed. (Washington, DC: The Agricultural History Society, 1988): 122-130. More recently, Mark

Chemical manufacturers and weed control experts responded quickly, introducing new types of chemicals, including new growth regulators as well as new contact herbicides that killed everything they touched. *Wallaces' Farmer* announced “New Weed Control Chemicals for 1961,” specifically two growth regulators, Amiben for soybeans and Atrazine for corn, as well as a new formulation of the contact herbicide amino triazole, called Amitrol. Experts recommended Radox and Atrazine for foxtail control in corn for the 1961 growing season while soybean growers could use Alanap, Radox and Amiben. Still, 2,4-D continued to be a mainstay for Iowa farmers, since broadleaf weeds remained in fields, pastures, and fencerows.³⁰

The new chemicals helped control the grasses, but they were more expensive than 2,4-D, requiring farmers to spend more money on herbicide in the 1960s than they had in the 1940s and 1950s. Rudolf Schipull, who began using 2,4-D in 1952, spent an average of \$11.36 per year from 1952 to 1958, not including 1957 when he recorded no herbicide or spraying expense. After spending an average of \$107.38 per year from 1959 to 1967 (mostly for 2,4-D and custom spraying), Schipull's herbicide expense changed dramatically the next year. In 1968 he purchased \$380.51 worth of Radox, Treflan, Atrazine and crop oil, and

Fiege's work on the irrigated landscape of Idaho demonstrates the futility of attempting to eliminate nature. According to Fiege, “nature changes what humans build, often in unanticipated ways; sometimes nature comes back more powerful than before,” an insight that informs the story of Iowa farmers' efforts to control nature through chemicals. *Irrigated Eden: The Making of an Agricultural Landscape in the American West* (Seattle: University of Washington Press, 1999), 9. Similarly, William Boyd claimed that “the history of industrial agriculture contains numerous examples of unforeseen and often disruptive effects of technological development” in “Making Meat: Science, Technology, and American Poultry Production,” *Technology and Culture* 42 (October 2001): 662-663. Hadley Read, “New weed threatens Cornbelt,” *Successful Farming*, June 1951; “Grassy Weeds Threaten,” *Wallaces Farmer*, 2 January 1954; “Learn More About Weed Control,” *Wallaces Farmer*, 1 January 1955; *Annual Report, Greene County, 1956*, 1-2; Fred W. Slife and Lloyd E. Zeman, “1965 Weed and Insect Control Guide,” *Successful Farming*, March 1965; “Grassy Weeds Threaten Iowa Cornfields,” *Wallaces Farmer*, 26 April 1969; “Chemical Control for Smartweed in Beans,” *Wallaces Farmer*, 25 April 1970; Bob Nymand interview.

³⁰ “What Can You Do About Foxtail?,” *Wallaces Farmer*, 18 February 1961.

Weedout. In 1969 the only herbicide he listed by name was 2,4-D, but he spent almost \$300 for it, while in 1970 he spent \$473 for seven different herbicides and custom application. It is impossible to know the particular weed conditions Schipull faced, but it is clear that he believed that the increasingly expensive chemicals could help control weeds in his fields.³¹

In addition to costing more money, herbicide represented a larger percentage of crop expenses in the 1960s than it had in previous decades. Joseph Ludwig's nominal herbicide expense for 2,4-D and the occasional supplement amounted to an average of 1.5 percent of total crop expenses from 1946 through 1960. During those years, that percentage ranged from a high of 7 percent in 1950 with no herbicide expenses recorded in 1949, 1957, 1958 and 1960. In 1961, Ludwig altered his operation significantly, recording 38 percent of crop expense devoted to herbicide. From 1961 to 1970, Ludwig's herbicide expenses averaged 29 percent of his total crop expense. Significantly, the average total crop expense for his farm during both periods was similar, with \$1,698 from 1946 to 1960 and \$1,683 from 1961 to 1970, indicating the extent to which herbicide became a major part of Ludwig's farm operation. Although the William Adams records ceased in 1958, his herbicide expenses were slightly higher from 1949 to 1958, averaging 7 percent per year, still a small commitment when compared to the post-1960 herbicide expenses.³²

Farmers like Ludwig who learned how to use herbicide by experimenting with 2,4-D faced an increasingly complicated lineup of herbicides to choose from during the late 1960s. Changing weed populations meant changes in herbicide tactics. As a farm journalist noted in 1969, "So many brands, so many different formulations with different rates of application

³¹ Schipull papers.

³² Ludwig papers.

and different costs, make selection of a weed killer a pretty tough job.” With nineteen herbicides for corn and twenty for soybeans available in 1969, the days of using just 2,4-D or a perhaps a contact, non-selective herbicide such as amino triazole were gone. The proliferation of new herbicide varieties and names could be confusing, with some chemicals such as Ramrod or Randox appropriate for corn and soybean fields, but Randox T and Londax only cleared for use in cornfields. A Hardin County extension director remarked in 1960 that farmers generally wanted to know what chemical to use on a particular type of weed, a contrast to earlier reports when farmers wanted to learn about the handful of chemical treatments on the market. In addition to offering information on the proper use of 2,4-D, he observed, “Many requests are for information on use and hazards of new weed chemicals,” suggesting sensitivity on the part of some farmers about finding the right herbicide for a particular weed problem and their concern about crop damage from misapplication, improper mixing, or carryover. Furthermore, dosages changed over time as weed problems changed and manufacturers modified product formulas.³³

Demonstration projects and the specifics of recommended dosages illustrate the complexity of selecting one or more herbicides. In 1967 Hamilton County extension staff cooperated with the Stanhope Co-op Elevator and a local farmer to manage a demonstration plot with ten different herbicides on beans and seven herbicides on corn. Henry County farmers saw a variety of chemicals in operation in 1966, when a demonstrator near Winfield compared broadcast pre-emergence application of three chemicals, Atrazine, Ramrod and Randox-T with post-emergence application of Atrazine combined with mechanical

³³ Charles E. Sommers and Ellery L. Knake, “1969 Corn-Soybean Herbicide Selection Guide,” *Successful Farming*, February 1969; *Annual Report, Hardin County, 1960*, 25; Richard Krumme, Phil Jones, and Charles E. Sommers, “Your Nine Big Corn Decisions,” *Successful Farming*, November 1970.

techniques. Dutch Sylwester recommended nine different chemicals that could be used for foxtail control in planted corn that had not emerged in 1967, with each chemical applied at a different rate. Yields varied widely, depending upon which chemical a farmer used, making herbicide use a trickier proposition than it had been in the 1950s.³⁴

The stakes were high in this complex weed control fight. Manufacturers contended that every dollar farmers invested in herbicide gave better returns from the same dollar invested in fuel, labor, and machinery costs of cultivating. In 1968 the Geigy Chemical Corporation argued that for every dollar's worth of Atrazine farmers could expect to gain up to \$4 through increased yield. Of course, farmers always understood that weeds robbed yields, but since the new generation of herbicide was more costly it made cost-benefit information a key point of advertising. Researchers at experiment stations proved that just a few weeds could decrease yields, confirming the advertisers' claims. One giant foxtail plant per foot of corn row cut yields from 93.5 bushels to the acre to approximately 86.5 bushels. Leland Bentley of Grundy County provided a dramatic example of the yield increasing potential of the new chemicals with an atrazine test he conducted in 1965. Bentley applied atrazine on a cornfield where the nut grass practically covered his four-inch high corn. At harvest time, the section where he applied the Atrazine yield nineteen bushels per acre higher than the control plot.³⁵

Application techniques were also in transition. Farmers used pre- and post-emergent spray herbicides and granules in the 1950s, but instructions varied from chemical to chemical. In the 1950s, most pre-emergent herbicides could be applied anytime after planting

³⁴ *Annual Report, Hamilton County, 1967*, 9; *Annual Report, Henry County, 1966*, 16-17.

³⁵ Geigy/Atrazine advertisement, *Successful Farming*, March 1968; "Know More About Your Corn Crop," *Wallaces Farmer*, 11 March 1967; *Annual Report, Grundy County, 1965*, 3.

and before the crop emerged, but newer chemicals required more sensitivity. The Amchem Company noted that there were numerous complaints about their product, Amiben, a herbicide labeled for soybean fields. According to a company representative, “it seems to me that the farmer still doesn’t fully understand how to use AMIBEN for most consistent results,” observing that farmers needed to apply it at the same time they planted for best results and implying that farmers need to relearn application practices to match the new chemicals.³⁶

Other techniques also required training, such as incorporating spray herbicide into the ground. Eli Lilly Company’s herbicide for soybean fields, Treflan, required mixing into the top layer of soil to get maximum contact with the delicate roots of emerging grassy weeds. Elanco worked to ensure success for the product, issuing a question and answer circular letter to county extension staff about proper techniques for using Treflan. The circular stressed the need to use a tandem disc and harrow to get the chemical mixed with soil properly. That year Elanco also published an extensive brochure, “New Dimension in Weed Control,” emphasizing “three-dimensional protection against weeds rather than just a thin veneer on the surface.” Incorporation was not a blanket approach, since not all herbicides were effective when incorporated and some could actually damage the crop. Chemicals that dissipated in air were good candidates for incorporation, while some, such as Treflan, decomposed faster in sunlight. Incorporation, like all the new techniques, required a higher degree of

³⁶ R. H. Beatty to D. W. Staniforth, 23 May 1966, enclosure, M. B. Turner to R. H. Beatty, 17 May 1966, D. W. Staniforth papers, Special Collections, Parks Library, Iowa State University.

sophistication in application. Mixing too deep diluted the chemical, while mixing too deep or too shallow meant that the chemical could miss the roots of the weeds.³⁷

Mixing herbicide varieties and using more than one kind in the same field also became a common practice during the 1960s. With the proliferation of herbicides designed to combat different types of weeds, it did not take long before farmers and researchers began combining herbicides to achieve broad-spectrum weed control. As one writer noted in 1966, “Combinations offer the possibility that someday, by mixing two, or perhaps several chemicals, you can tailor a prescription herbicide to your specific weed problem.” Farmers who mixed herbicides could not only get broad-spectrum weed control, but they could also match local soil or weather conditions, reduce the risk of carryover of one full strength chemical, and potentially cut the risk of crop injury and costs. In 1967 and 1968 the USDA approved several chemicals for mixing, including Atrazine and Lorox, Atrazine and Ramrod, and Ramrod and Lorox. Manufacturers registered more chemicals for mixing in 1969, prompting Dutch Sylwester to comment “contrary to what some folks believe, these combinations are not being made to confuse you.” Experts cautioned that farmers who did not purchase premixed herbicides needed to exercise caution when they mixed the chemicals in the tank to make sure that the herbicides were in the proper proportions. Farmers who found that one kind of chemical did not provide the degree of control they desired could apply another round of herbicide. Leroy Aswegan of Hardin County applied Treflan before

³⁷ “Dear County Agent” circular, 7 April 1965, Staniforth papers; “New Dimension in Weed Control,” Elanco Products Company, Indianapolis, Indiana, brochure EA 5065; Keith Remy, “Which Herbicides Should Be Incorporated Into The Soil?,” *Wallaces Farmer*, 9 April 1966; “Work Herbicides Into The Soil?,” *Wallaces Farmer*, 8 April 1967; “Incorporating Herbicides—Helpful With Some,” *Successful Farming*, March 1968; “Incorporating Chemicals,” *Wallaces Farmer*, 9 May 1970.

planting and then planned to apply a preemergent treatment of Lorox in 1971. Aswegan explained, “I think I need a second layer of chemical weed control.”³⁸

Mixing and making multiple applications were not the only way that herbicide formulations became more complicated. Surfactants, or surface-active agents, helped the dispersing, spreading, wetting, sticking and other surface-changing properties of the plants. Using surfactants became popular in the 1960s as a way of getting the most out of the herbicide. Some farmers used Atrazine with crop oil as a post-emergence spray to increase absorption into the weeds. The oil not only helped the herbicide penetrate the leaf, but, unlike a straight water mix that would evaporate quickly, the oil kept the unabsorbed chemical on the plant, gradually moving it to the base where it could be taken at ground level. Using surfactants gave farmers another way to get the most weed control from their increasing herbicide expense.³⁹

The variety of herbicides and the combinations brought new risks, too. The new herbicide residues persisted longer in the soil and could carry over into the next year and affect non-tolerant crops. As early as 1949, weed scientists assured farmers that 2,4-D dissipated from the soil from thirty to ninety days, quieting any fears of the new technology. By the late 1960s farmers had good reason to worry about carryover. As Dutch Sylwester noted in early 1969, the 1968 crop suffered damage from 1967 Atrazine carryover due to late season “rescue” applications, compounded by dry conditions throughout the growing season and into the following spring, which prevented chemical breakdown. Studies indicated that

³⁸ “Are Two Herbicides Better Than One?,” *Wallaces Farmer*, 5 March 1966; “Herbicide Mixtures for Weed Control,” *Wallaces Farmer*, 8 April 1967; “Herbicide Mixtures Offer Some Benefits,” *Wallaces Farmer*, 12 April 1969; “Piggyback sprays: new way to clean out weeds in soybeans,” *Farm Journal*, April 1971.

³⁹ An excellent resource for the terminology and technology of herbicides is Robert King, editor, *Farmers Weed Control Handbook* (St. Louis: Doane Publishing, 1985). “How Surfactants Improve Weed Killers,” *Wallaces Farmer*, 9 March 1968; “Timing Critical When Applying Atrazine-Oil,” *Wallaces Farmer*, 10 May 1969.

Atrazine, unlike 2,4-D, could remain active in the soil from four to twelve months, depending on the amount applied per acre. As noted, farmers could mix herbicides to reduce the risk of carry over, but it required careful planning to ensure that the next year's crop was tolerant to the selected herbicides. It was possible to mix two chemicals at a slightly lower application rate to lessen the chance that one of the herbicides would leave damaging residue for the next year's rotation.⁴⁰

While some farmers used herbicide to reduce their cultivation efforts in the 1950s, a few hoped to eliminate cultivation altogether in the 1960s. In 1949 an optimistic USDA weed scientist prophesied that farmers could eliminate cultivation with the aid of chemical weed killers. In the mid-1960s some experts, farmers, and journalists began to consider minimizing their summer fieldwork, actually substituting chemicals for cultivation along with narrowing the rows in their fields. John Engelkes of Franklin County applied a heavy dose of incorporated Atrazine in 1965 on a germinating corn crop, noting that he did not need to cultivate that season. He did cultivate twelve acres as a control plot, noting that there was no visible difference in the quality of the crop between the herbicide treated fields and the twelve acre control plot. Although he did not weigh samples to get an accurate yield test, he was encouraged enough to try it again in 1966. Bob Gabeline of Louisa County found that with granule application of Randox, he avoided cultivating on a portion of his acres. Gabeline cultivated three fourths of his corn one time, with the balance of his fields receiving only two passes with the cultivator. Herbicide costs were higher for this sort of replacement

⁴⁰ Wally Inman, "2,4-D Rules for '49," *Wallaces Farmer*, 15 January 1949; "Weed Control for Corn and Soybeans," *Successful Farming*, February 1969; "Fit Chemical to Crop Rotation," *Wallaces Farmer*, 8 March 1969; EPA Hazardous Materials Advisory Committee, *Herbicide Report: Chemistry and Analysis, Environmental Effects, Agricultural and Other Applied Uses* (Washington, D. C.: U. S. Government Printing Office, May 1974), 58.

operation, but a Lucas County farmer noted that the cost difference was “more than paid for from yield increases and timeliness.” He explained, “We have livestock and a considerable amount of hay. By not having to spend time cultivating beans, we gained extra time to take care of our corn, hay, and livestock.” Farmers who used herbicide to gain time for other farm operations recognized that their labor could be more profitably employed elsewhere on the farm.⁴¹

From 1945 to 1970, farmers who used growth regulator herbicides only realized part of the optimistic promise of cheap and easy chemical control. Chemicals became a critical element of Corn Belt agriculture although cultural control was still important. Farmers experienced problems in using growth regulator herbicides, most notably frequent crop damage through misapplication, but chemicals were reliable enough to inspire confidence in most farmers. They found that it helped them control problem weed areas, catch up with weed control when it was too wet to cultivate, gave them a head start on cultivating when they applied pre-emergent herbicides, and even let them replace cultivation. Farmers welcomed the new chemical technology, but they played a critical role in shaping its use, as well as altering ecosystems. Their very reliance on 2,4-D compounded an inherent problem of that chemical, since it only controlled broadleaf weeds and not grasses.

As farmers grappled with the changing weed profile on their land, they found new ways to manage an old problem. A host of new chemicals and new techniques allowed farmers to maintain a degree of control over the grasses, but at a dramatically higher cost and degree of complexity. Growth regulator herbicide was a practical and inexpensive solution

⁴¹ Untitled Editorial, *Wallaces Farmer*, 21 May 1949; Roy J. Reiman and Lloyd E. Zeman, “These Farmers Shoot the Works on Corn,” *Successful Farming*, March 1965; Ken Hofmeyer, “Growing Row Crops Without Cultivation,” *Wallaces Farmer*, 23 April 23 1966.

to the postwar weed problem when farmers began using it on a trial basis in 1945, but the relationship between farmers, growth regulator herbicide, and Iowa's farmland was constantly changing as farmers attempted to maximize production and deal with the unintended consequences of the new technology. By 1972, however, few Iowa farmers debated whether or not to use herbicide. Instead, they debated what kind to use and how to apply it. It was as important for farmers to know about herbicide as it was to know about tractors and corn. Increased yields and reduced field labor were powerful incentives for farmers to make the transition to chemical weed control. As Iowa farmers accepted herbicide and asserted initiative in using it, they combined it with chemical fertilizer and insecticide, increasing their commitment to corn and soybeans and livestock, reshaping the postwar farm landscape.

CHAPTER THREE

Fertilizer Gives the Land a Kick

In early 1944 a farmer from Poweshiek County noted that over the previous seven years commercial fertilizer helped him get better yields on his pasture. “It gives the land a kick,” he explained. The small number of Iowa farmers who used commercial fertilizer on their crops of corn, small grains, hay, and pasture reported that they had significant gains in yield, a fact confirmed by Iowa State College Extension experts. These scientists and county extension directors told farmers that in addition to pasture, hay, and small grain acres, as much as half of the corn acres in the state could benefit from commercially manufactured nitrogen, phosphorous, or potassium to boost yields, depending on soil type. Experiments from around the state showed that fertilizer stimulated root, leaf, stalk, and ear growth on corn plants and increased production on legumes such as alfalfa, too. At the end of World War II, farmers all over Iowa confronted the possibilities of commercial fertilizer.¹

Throughout the 1920s and 1930s, only a minority of Iowa farmers purchased fertilizer. Less than 5 percent of Iowa farmers in 1929 and 3 percent in 1939 used fertilizer, a stark contrast to the practices of farmers in Corn Belt states to the east. In Ohio and Indiana farmers used it extensively, with 62 and 49 percent of farmers in those states, respectively, using fertilizer at mid-century. Most farmers in Iowa eschewed purchasing fertilizers because they were successful in maintaining productivity with regular applications of manure and crop rotations of corn, small grain, and hay. For decades, the majority of farmers who used fertilizer were those who specialized in crops that had high labor requirements and had high returns such as truck crops or vegetables. One writer, discussing the rapid spread of

¹ “Dollar Corn Makes Fertilizer Pay,” *Wallaces Farmer*, 15 January 1944; “Farmers Talk About Fertilizer Use,” *Wallaces Farmer*, 20 January 1945.

commercially purchased chemical fertilizer, claimed that in his boyhood people looked down on fertilizer as a “whip to the tired horse.” The allusion to the whip and tired horse implied that only farmers who failed to care for their land needed to fertilize, just as only careless or cruel farmers lashed their horses. A successful crop rotation strategy also limited populations of yield robbing weeds and insects. But after World War II farmers in Iowa and across the Corn Belt used commercial fertilizer as a regular part of their land and crop management routines for all their crops, especially corn and soybeans.²

Iowa farmers participated in a national trend toward chemical fertilizer use. From 1945 to 1970 the use of nitrogen on American farms increased from 419 million tons to 7,459 million tons while the use of potash increased from 435 million tons to 4,035 million tons. Iowa farmers increased their total fertilizer use from 332,661 tons in 1950 to 2,333,411 in 1969 without significantly altering their total crop acreage. By 1972, farmers used increasing amounts of fertilizer on their corn crop in the pursuit of larger yields. They also successfully pioneered the use of nitrogen fertilizer for the soybean crop, helping to increase the importance of soybeans in Iowa agriculture.³

The most important question that occupied journalists, extension professionals, and farmers was whether or not fertilizers helped increase yields enough to make them economical. Some Iowa farmers used fertilizers to compensate for deficiencies of their soil

² “Says Use More Fertilizer,” *Wallaces Farmer*, 19 January 1946; Zenas H. Beers, “Development of the Fertilizer Industry in the Middle Western States,” *Fertilizer Review*, 26 (April-May-June 1951), 5; Bogue, *From Prairie to Corn Belt*, 285-286; “Fertilizers and Lime In the United States: Resources, Production, Marketing, and Use,” USDA *Miscellaneous Publication No. 586* (Washington, D.C.: U. S. Government Printing Office, May 1946), 26, 28, 85; “More Farmers Use Fertilizer,” *Wallaces Farmer*, 19 April 1952.

³ Willard Cochrane, *The Development of American Agriculture* (Minneapolis: University of Minnesota Press, 1979), 127-128; USDA Crop Reporting Board, Statistical Reporting Service, “Consumption of Commercial Fertilizers, Primary Plant Nutrients, and Micronutrients,” *Statistical Bulletin No. 472*, (Washington, D.C.: U. S. Government Printing Office, 1971). For a survey of the fertilizer business, see Lewis B. Nelson, *History of the U.S. Fertilizer Industry* (Muscle Shoals: Tennessee Valley Authority, 1990).

type, such as William Adams of Fayette County, who bought one or two tons of phosphate each spring throughout much of the 1930s. But the low commodity prices and subsequent low farm income of the 1930s made purchasing fertilizer a difficult or losing proposition for the majority of farmers, especially those who did not have any experience with commercial chemicals. High wartime prices for almost all farm products prompted farmers who had not used fertilizer during the depression years to consider it. Subscribers to *Wallaces' Farmer* read about peers who used high analysis fertilizer, a blend of nitrogen, phosphorous, and potassium represented by three numbers that indicated the percent of plant food per 100 pounds. For example, 0-9-27 fertilizer was a mix of 0 percent nitrogen, 9 percent phosphorous, and 27 percent potassium, with the rest of the blend as carrier. The magazine's editors proclaimed that "Fertilizers Get Results," "Fertilized Corn Does Better," and "Grass and Fertilizer Work Together," citing studies that proved the tremendous yield-boosting potential of commercial fertilizer.⁴

Promoters' claims of the value of purchased fertilizer were compelling reading. Check plots on pastures showed that animals gained more weight grazing on fertilized pastures. One study showed that steers on a pasture with phosphate applied at 155 pounds per acre gained 155 pounds per acre, while the steers on the check plots only gained 105 pounds per acre. Similarly, rotated corn fields treated with animal manure, limed, and fertilized with 150 pounds of 0-20-0 per acre yielded seventy-eight bushels to the acre, while fields treated with 200 pounds of 2-12-12 yielded eighty-five bushels of corn to the acre. These yields were remarkable considering the average yield during the 1950s varied from the

⁴ Adams papers; "Fertilizers Get Results," *Wallaces Farmer*, 5 October 1946; "Fertilized Corn Does Better," *Wallaces Farmer*, 6 April 1946; "Grass and Fertilizer Work Together," *Wallaces Farmer*, 2 March 1946.

forties to a high of sixty-six in 1958. Throughout the 1950s and 1960s, farmers and experiment station researchers regularly reported gains of ten or more bushels to the acre on fertilized fields.⁵

While most farmers chose to apply fertilizer over the course of the postwar years, more prosperous and younger farmers did so faster than others. In a survey of over 500 farmers statewide conducted by the state experiment station and Iowa State college statistical laboratory in the early 1950s, the wealthiest farmers used the most fertilizer, while over half of the farmers surveyed would have used more if they could afford it. Another survey suggested the ways in which age played a part in farmers' decisions to use fertilizer. In 1952, 56 percent of farmers under thirty-five years of age planned to use starter fertilizer on corn fields applied at planting time, followed by 50 percent of farmers aged thirty-five to fifty, and only 40 percent of farmers older than fifty. Older farmers relied on a system of crop rotation to balance nutrient use and used animal manure to put organic matter back into the soil. The Jefferson County extension director reported that older farmers there would "probably never give in to fertilizer use, but the younger ones are showing increased interest." This generation gap continued into the 1960s, when another poll indicated that 71 percent of farmers aged thirty-five to fifty planned to use starter fertilizer on their 1963 corn crop and 66 percent of the group aged fifty through sixty-four would do so. Only 31 percent of farmers over age sixty-five planned to use starter fertilizer, with the youngest farmers trailing slightly behind the middle-aged leaders.⁶

⁵ "Farmers Get Results:" *Annual Report, Jefferson County, 1958*, 11.

⁶ "More fertilizer every year," *Wallaces Farmer*, 7 August 1954; "More Farmers Use Fertilizer," *Wallaces Farmer*, 19 April 1952; *Annual Report, Jefferson County, 1957*, 6; Newt Hawkinson, "Starter Fertilizer," *Wallaces Farmer*, 20 April 1963.

Older farmers were not the only ones who were slower to take up chemical fertilizer. Farmers with smaller acreages also lagged behind those with large areas under cultivation. As farmers employed herbicide to reduce labor demands at cultivating time, insecticide to limit yield losses due to insect infestation, and spread the cost of their machines over more acres, they wanted to ensure high yields by using fertilizer. Eight of ten farmers with more than 150 acres of corn planned to use starter fertilizer on their corn in 1963 while only 50 percent of those with less than twenty-five acres planned to use it. These farmers with small acreages might have had more livestock, enabling them to put more manure on their land per acre than those with extensive farms. Perhaps the farms with small corn acreages were farmed by older farmers who were slower to use the new technology. But it is also possible to see 50 percent of farmers with less than twenty-five acres of corn who used fertilizer as a high number, indicating that they agreed with larger operators that fertilizer was a good technique.⁷

Regardless of their age group, farmers of the 1940s and 1950s had good reasons for using commercial fertilizer. The most compelling reason is that returns from fertilizer generally exceeded costs. Of the 69 percent of Iowa farmers who used commercial fertilizer in 1953, 87 percent of them believed that their crops benefited from the application. They believed it worked because they saw it on their neighbors fields and heard them talking about it. Over half of farmers surveyed reported that it was the experiences of other farmers that convinced them to try fertilizing. By contrast, only 20 percent of farmers began to use

⁷ Hawkinson, "Starter fertilizer."

fertilizer because of the efforts of the Extension service or farm magazines. If there was ever a product that “sold itself” to farmers, it was commercial fertilizer.⁸

Farmers accepted commercial fertilizer so quickly because of the experiences with hybrid corn, a technological development they adopted in the 1930s and 1940s. They learned that they needed to fertilize the new hybrids to obtain maximum yields. As farmers retired corn acres after 1933 as part of the Agricultural Adjustment Administration’s corn-hog program they offset declining production by using higher yielding hybrid corn on their remaining corn acres. When the US government lifted production controls during World War II, hybrid seed continued to be important, since government leaders wanted maximum production for the war effort and commodity prices soared. By 1942 all Iowa corn acres, regardless of farm size, were planted with hybrid seed corn. Higher yielding hybrid corn crops utilized more of the available soil nutrients, drawing down supplies of nitrogen, phosphorous, and potassium at a faster rate than with open-pollinated varieties.⁹

Just as using hybrid seed increased the pressure on soil nutrients, so too did the trend to plant thicker stands of corn. The mechanical and chemical farming techniques of the postwar period allowed more intensive farming as well as more extensive farming. With new pesticides (see chapters one and two) and fertilizers to help keep fertility high, farmers abandoned the old check-row planting grid system that facilitated cultivation. Their new strategy was to plant narrow corn rows and plant more plants per acre. Both of these

⁸ M. A. Anderson and E. L. Baum, “How Your Neighbors Use Fertilizer,” *Iowa Farm Science* 11 (April 1957): 26-28. For a full report on farm fertilizer use in 1953, see M. A. Anderson, L. E. Cairns, Earl O. Heady, and E. L. Baum, “An Appraisal of Factors Affecting the Acceptance and Use of Fertilizer in Iowa, 1953,” Agricultural Experiment Station, Iowa State College, Ames, Iowa, *Special Report No. 16*, June 1956.

⁹ Hudson, *Making the Corn Belt*, 171; Firman E. Bear, *Soils and Fertilizers*, 4th ed. (New York: John Wiley and Sons, Inc., 1951), xi; “What big yields do to soil fertility,” *Wallaces Farmer*, 2 November 1963; G. F. Sprague and J. C. Cunningham, “Growing the Bumper Corn Crop,” in *A Century of Farming In Iowa, 1846-1946* (Ames: Iowa State College Press, 1946), 41.

developments made fertilizer an important part of Corn Belt farming. As a result, perspectives on what constituted good farming changed as older farmers and those with smaller and moderate sized farms moved out of agriculture. Fertilizer, previously viewed as the whip to the tired horse used by inferior farmers, was now perceived as a legitimate technology. Families who continued to farm considered the purchase and use of commercially manufactured chemical fertilizer an essential part of good farming.¹⁰

Farmers accepted fertilizer as a valuable tool that could help boost yields and farm profits by raising more crops per acre, but it was another matter to determine what kind of fertilizer matched local soil types how and when to apply fertilizers, and even what crops responded best to chemical treatment. Fertilizer application could take place at various times throughout the year, and the popularity of each application technique varied. Some farmers submitted soil samples to the laboratory at Iowa State for testing, but as late as 1962 farmers only tested soil on 20 percent of Iowa's corn fields. Farmers found that expert advice was frequently helpful, but not always. Many farmers experimented on their own to find out what worked best for their conditions or type of operation. Much of the discussion about fertilizers in the years up to 1972 involved the timing and method of application.¹¹

Farmers and experts agreed that applying fertilizer at corn planting time, known as starter fertilizer, allowed the plant to get off to a fast start to maximize the chances for high yields. A farmer from Lyon County explained that he plowed under nitrogen and phosphate on his corn fields but also applied starter fertilizer. He noted that getting corn growing

¹⁰ The process of balancing the draw down of soil nutrients and the application of fertilizer has been labeled the "mechanization of the nitrogen cycle" and, in combination with hybrid technology, accounted for the increase in corn yields in the postwar period. James O. Bray and Patricia Watkins, "Technical Change in Corn Production in the United States, 1870-1960" *Journal of Farm Economics* 46 (November 1964): 762-763.

¹¹ "Are you using enough fertilizer?," *Wallaces Farmer*, 3 February 1962.

quickly put it ahead of weeds, which allowed earlier cultivation or herbicide spraying.

Garland Byrnes of Allamakee County recounted that “One year I ran out [of fertilizer] and left two rows without hill [starter] fertilizer. You could see a real difference in size of plants.” In 1953 Ray Griffieon of Polk County claimed that using starter fertilizer increased his corn yield by ten bushels per acre, pushing his yield to 100 bushels per acre, well above average corn yields in the state.¹²

Throughout the 1950s and 1960s, both farmers and extension professionals insisted that starter fertilizer made a substantial difference in yields. Even in the dry years of the mid-1950s when many farmers cut back on fertilizer purchases, some farmers maintained that it was a good gamble. In 1956, in the midst of a state-wide drought, Oliver Hansen of Franklin County explained that starter fertilizer “pays well at least four years out of five. Sometimes, I get as much of 15 to 20 bushels of corn for only four dollars worth of fertilizer.” According to this logic, not using commercial fertilizer was the real gamble.¹³

A key component of successfully applying starter fertilizer was the location of the chemical in the seed bed in relation to the seed. Early starter fertilizer applicators placed the granule of fertilizer next to the seed. According to a 1953 guide to fertilizer use, corn fertilizer needed to be at the same level as the seed and about two inches away from it. Later in the decade experts urged farmers to place the fertilizer lower in seedbed and to the side. This would prevent direct contact of the seed and fertilizer at germination time, which would delay germination. Instead, the fertilizer would be in position so that the first downward root shoots would reach the fertilizer. As one Webster County farmer put it, “We used to limit

¹² “Apply fertilizer with planter,” *Wallaces Farmer*, 16 April 1955; “Fertilizer Keeps Corn Yields High,” *Wallaces Farmer*, 7 November 1953.

¹³ Al Bull, “Cut down on fertilizer?,” *Wallaces Farmer*, 3 March 1956.

what we put on as starter...But now with placement away from the seed we'll be using more." The use of starter fertilizer did not preclude using other techniques such as spring or fall plow down, as Lloyd Fosseen of Hardin County noted. I think plow down followed with starter is the best, he noted. "It gets the corn started and keeps it going." This type of combination was especially popular with fertilizer applied during the growing season.¹⁴

Starter fertilizer was the most popular method of fertilizer use in the late 1940s and early 1950s. In 1951 only 38 percent of farmers reported that they used starter fertilizer, while 62 percent stated that they did not use it. By contrast, in 1952, 48 percent of farmers planned to use starter fertilizer while 47 percent did not, representing a significant gain over the previous year. Just as striking was the conversion of the undecided farmers, who comprised 5 percent in 1951 but likely moved into the ranks of those who planned to use fertilizer, since there were no undecided farmers in the 1952 poll. By 1963 65 percent of farmers surveyed planned to use starter fertilizer. This trend toward starter fertilizer matched the recommendations of agronomists and farm journalists, who argued that tests on experiment station farms indicated that broadcasting fertilizer required almost twice as much fertilizer as using a planter attachment to get the same results in yields.¹⁵

Once the corn crop was above the ground, boosted by starter fertilizer, many farmers applied nitrogen to the growing stand. In the 1950s experts discussed the need for nitrogen during the growing season. As one journalist explained in a 1950 article, "Nitrogen is a growth-producing plant food something like protein for animals." Farmers liked to see dark

¹⁴ "Guide to Fertilizer Use," Iowa State College Agricultural Extension Service, Ames, Iowa, *Pamphlet 193*, March 1953; "Put starter in the right place," *Wallaces Farmer*, 20 April 1957; "Early boost from starter," *Wallaces Farmer*, 5 April 1958; "Use both starter and plow-down fertilizer," *Wallaces Farmer*, 1 March 1961.

¹⁵ "More Farmers Use Fertilizer," *Wallaces Farmer*, 19 April 1952; Hawkinson, "Starter fertilizer"; "Fertilizer For Late Corn," *Wallaces Farmer*, 17 May 1947.

green corn fields, which indicated that the crop was healthy and had a good supply of nitrogen. While they traditionally used crop rotations to make sure that the nitrogen content in their soil stayed high, there was also the new possibility of performing a mid-season operation called side-dressing to get nitrogen to the plants in June or July. Farmers could side-dress nitrogen as they cultivated, mounting fertilizer applicators on their cultivators to get the fertilizer beside the corn row, making it available to the growing corn root systems. Iowa State College experiments in 1948 and 1949 showed that side-dressing forty pounds of nitrogen per acre gave an average of thirteen and a half bushels per acre yield increase. From the perspective of farmers such as Bill Wilson of Keokuk County, "It really pays off. I get three dollars for each one that I spend that way [side-dressing corn]." Side-dressing was a good way to ensure that a growing crop had a chance to mature.¹⁶

Side dress application of nitrogen was especially important on second year corn, the year before it was scheduled to go back into small grains followed by hay for the next year. Agronomists did not consider it necessary to fertilize corn that followed a legume crop in the rotation, but they estimated that as much as 90 percent of Iowa's second year corn would benefit from side dressed nitrogen. However, experts cautioned that this mid-season application was not a replacement for proper rotation. Planting corn on land more than two years in a row was bad farming, which risked depleting soil nitrogen to a degree that following crops of nitrogen-fixing legumes could not replace. But in remarkably short period, farmers found that using nitrogen in combination with herbicide and insecticide allowed them to raise corn for three or more years, with some farmers even planting

¹⁶ Homer Hush, "Yellow Corn Short of Nitrogen," *Wallaces Farmer*, 17 June 1950; "For more corn add nitrogen," *Wallaces Farmer*, 21 May 1955.

“continuous corn” in the same ground year after year. The key ingredient of continuous corn was a heavy dose of fertilizer with nitrogen rate of up to 200 pounds per acre. More commonly, farmers used fertilizer in combination with pesticides to rotate corn and soybeans.¹⁷

Anhydrous ammonia quickly became the leading fertilizer for side-dress operations on Iowa corn fields. At 82 percent nitrogen, it was the purest form of fertilizer available. Anhydrous ammonia is a gaseous form of nitrogen stored under pressure and injected into the soil at cultivating time, just as the solid or liquid forms of nitrogen, except anhydrous ammonia dissipated when it came in contact with air. In 1950 Elmer Carlson of Audubon County was one of the first farmers in the state to use anhydrous ammonia, but he was not alone for long. Farmers quickly adopted the gaseous form, which required less handling than the bags of solid fertilizer. Harold Whittlesey began farming in the northern part of the state in 1961, and by 1965 he applied anhydrous ammonia in late May. By 1968 Whittlesey only applied anhydrous ammonia, having phased out his other fertilizer products. Whittlesey, like so many Iowa farmers, found that it was easier to hire a commercial applicator for this task, which represented a time savings that allowed farmers to get on with other work during the busy month of June when they could make hay or take care of livestock. As a writer for *Wallaces Farmer* noted, “Frequently, custom applied nitrogen is cheaper than you can buy

¹⁷ “Plan To Side-Dress Your Corn?,” *Wallaces Farmer*, 2 February 1952; Hush, Yellow Corn Short of Nitrogen”; “Good year to side dress corn,” *Wallaces Farmer*, 20 May 1960; Roswell Garst, “‘Bob’ Garst’s Latest ‘Crusade,’” *Successful Farming*, July 1962; Rex Gogerty, “Corn after corn after corn,” *The Farmer’s Digest*, 34 (February 1971): 20-22.

and put on yourself.” Extant farm record books indicate that by the 1960s almost all farmers used anhydrous ammonia at some point in the year, often as side dressing.¹⁸

While starter fertilizer and side dressing with anhydrous ammonia gained popularity in the 1950s, many farmers found that spring plow down application was advantageous. Plowing down fertilizer meant broadcasting fertilizer on the surface of the field followed by plowing the field, which put the fertilizer deep in the seed bed. In the late 1940s, extension professionals hesitated to recommend plow down application unless the farmer could use large amounts of nitrogen, since the principal advantage of plowing down fertilizer was getting plant food where it could be absorbed by the roots throughout the growing season. Ray Gribben, a farmer from Dallas County, noted in his diary that he was very satisfied with his 1947 corn yields on the land he had fertilized in the spring of the previous year. Carl and Bertha Peterson, who farmed 110 acres in Palo Alto County, performed March or April application and plow down throughout the years up to 1970.¹⁹

Spring plow down was especially valuable to those families with larger farms or with demands on their time from extensive livestock operations. Farmers in the 1950s extolled the virtues of plowing down fertilizer for corn, especially the benefit of cutting the work load at planting time. One Hamilton County farmer explained that his method of applying phosphorous and potash in February and nitrogen in March, just ahead of plowing on second year corn ground, was “a plain case of now or not at all.” Without extra labor to help at planting time to haul fertilizer and fill planter attachments, he was able to use more of his

¹⁸ “Give Corn Fields Gas,” *Wallaces Farmer*, 15 July 1950; Haight/Whittlesey Papers, State Historical Society of Iowa, Des Moines; “Use nitrogen for more corn,” *Wallaces Farmer*, 15 May 1954; “Side dress nitrogen for your corn,” *Wallaces Farmer*, 5 May 1962.

¹⁹ “Figure Plant Food In Fertilizer,” *Wallaces Farmer*, 4 January 1947; Gribben diary, 30 November 1947, State Historical Society of Iowa, Iowa City; Carl and Bertha Peterson papers, State Historical Society of Iowa, Des Moines.

daylight hours actually getting the corn crop in the ground in May. Iowa State College's agronomist H. R. Meldrum gave this technique a qualified endorsement, recognizing the labor shortage and noting that it was better than no fertilizer at all. However, he cautioned that some of the fertilizer could wash away before it could be plowed under and that plow down fertilizer was too deep to help get the young plants growing the way starter fertilizer did.²⁰

Farmers cited other advantages of plow down application. Bill Patterson of Madison County planned on plowing under fertilizer for the first time in the spring of 1953, citing the hectic demands of June that kept him from getting into the field to side-dress corn with nitrogen. "Side dressing nitrogen on corn comes at the wrong time for me," he explained. "Corn, beans, hay and hogs all need attention at the same time. If I can broadcast nitrogen in April, it will save a lot of time during the busiest season." Plow down application offered another perceived advantage, since the fertilizer was lower in the seedbed than it was with side dressing. According to Walter Krauter of Lee County, plow under fertilizer was "deep enough that corn roots get to it before the weeds. Some weeds never do get much of it [fertilizer] that way." Farmers such as Krauter turned the experts' advice of starter fertilizer upside down, arguing that shallow-placed starter fertilizer was available for the weeds, too. Proponents of plow down fertilizer believed that it was the best solution for the entire growing season and helped solve farm labor problems.²¹

In the late 1940s and early 1950s agronomists began to advise applying fertilizer in the fall as an alternative to spring plow down application. They argued that just as much of

²⁰ "What Time For Fertilizer?," *Wallaces Farmer*, 15 March 1952.

²¹ "Plow Under Corn Fertilizer," *Wallaces Farmer*, 7 June 1953; "Boost your fertilizer profits," *Wallaces Farmer*, 16 April 1955.

the nutrients would be available the following spring as fertilizer applied just before planting. Extension agronomists initially promoted fall application of phosphate and potash for winter wheat and second year pastures or hay ground in 1949 through 1951. But in 1952 they began to promote fall fertilizing with high analysis chemical for corn ground. Extension agronomist Lloyd Dumenil explained that applying fertilizer before fall plowing made sense. He argued that there was little chemical leaching or runoff of the fertilizer over the winter because fall precipitation was generally lighter than that of the summer months. The biggest opportunity for runoff was in the spring, but since that was when most farmers applied fertilizer there was little additional risk associated with fall application.²²

Fall application could also save time in the spring when farmers were traditionally busy with seedbed preparation, hauling manure, and planting crops. This was especially true for farmers who were expanding their acreage or dedicating a larger portion of their acreage to corn. In 1955 Weldon Franzeen of Greene County testified about his experiences with fall fertilizing over the past two seasons. "Fall application does just as well as spring for me. I save a lot of work by having the fertilizer bulk spread." Franzeen explained that it was more economical to hire a commercial bulk spreader to do the job faster than he could do it himself. Gene Casey of Johnson County explained that fall application of nitrogen at plowing time saved a trip over the field in the spring, which also saved costs for fuel. This preemptive work in the fall "hurries field work when time is critical" in the spring. "If you wait until spring," another Johnson County farmer cautioned, "you run the risk of weather, a shortage of time, and not getting the fertilizer when you need it." These farmers used fall

²² "Use Fertilizer This Fall," *Wallaces Farmer*, 17 September 1949; "Spread Fertilizer In The Fall?," *Wallaces Farmer*, 15 September 1951; "Fertilize This Fall For 1953 Crop," *Wallaces Farmer*, 20 September 1952; Lloyd Dumenil, "It's smart to fall fertilize," *Successful Farming*, October 1953; Lloyd Dumenil, H. R. Meldrum, and John Pesek, "When to fertilize? Fall or Spring," *Iowa Farm Science*, 9 (September 1954): 3-6.

application of nitrogen as a means of hedging against weather delays, the most volatile variable of farming.²³

Farmers' testimony about the benefits of applying fertilizer in the fall rather than plowing down fertilizer in the spring also included an appeal to the pocketbook that was hard to resist. Fertilizer distributors offered lower prices in the fall than they did in the spring, providing an additional incentive to get fertilizer in the ground in the fall. A Humboldt County farmer found that "Buying it in the fall saves me about \$9 a ton when I shop around a little." Not all farmers agreed, of course. Carroll Swanson of Webster County stated that he preferred having the money in the bank rather than "in the ground." Yet the chance to buy at a discount and avoid incurring storage costs over the winter was attractive during times of rising costs and stagnant or falling prices.²⁴

A minority of farmers seized the potential cost and labor savings of fall fertilizing in the 1950s. In 1953, just one year after farm journalists and agronomists began to actively promote fall fertilizing; 17 percent of farmers surveyed in a Wallace-Homestead Poll responded that they planned on spreading fertilizer in the fall for their 1954 crops. More farmers would have used fertilizer had the autumn not been so dry, since fewer farmers chose to plow in a dry year for fear of moisture loss. By 1959 18 percent of farmers applied fertilizer in the fall and spring, while 78 percent only applied it in the spring. The potential

²³ "More Fertilizer Applied in Fall," *Wallaces Farmer*, 16 January 1954; "Fall application of fertilizer," *Wallaces Farmer*, 20 August 1955; Bob Dunaway, "Fall soil fertility program," *Wallaces Farmer*, 28 October 1967.

²⁴ Jim Johnson, interview by author, 21 June 2004, Eldora, Iowa, tape recording; "Apply fertilizer in the fall," *Wallaces Farmer*, 17 August 1957.

for increased yields as well as labor and cost savings motivated a small group to pursue fall application.²⁵

In the 1960s extension professionals urged farmers to use caution with when applying nitrogen fertilizer in the fall. They offered new technical advice and qualifications regarding fall application, including warnings of possible nitrogen loss. There had been little concern among agronomists about phosphorous and potassium loss, but as fall application of nitrogen became more common, their concern heightened. Agronomists issued their first admonitions about fall application regarding anhydrous ammonia in 1955. Since anhydrous ammonia was a gas that needed to be put into the soil lest it dissipate, it was critical to inject it into the soil at least four inches deep. Injecting the gas at the proper depth allowed the nitrogen to bond with the soil.²⁶

Controlling the depth of application was simple compared to the other guidelines of the 1960s. In 1962 and again in 1964 extension agronomists backed away from a blanket endorsement of fall nitrogen applications. Agronomist John Pesek cautioned that “Fall applications of nitrogen are inferior to early summer applications, but we can’t tell how much inferior they are.” To avoid losses, he counseled waiting until two to three weeks before the nitrogen was actually needed. Cooler soil temperatures prevented ammonium nitrogen from becoming a soluble nitrate that was more likely to run off, a process called denitrification. Specialists urged farmers who applied fall nitrogen to wait until the soil temperature reached fifty-five to fifty-seven degrees for the 1962 season, revising those figures downward to fifty to fifty-five degrees by 1964. In 1965 the recommended soil temperature was no more than

²⁵ “More Fertilizer Applied in Fall,” *Wallaces Farmer*, 16 January 1954; “Iowa soil gets more fertilizer,” *Wallaces Farmer*, 17 January 1959.

²⁶ “Apply nitrogen in the fall?,” *Wallaces Farmer*, 1 October 1955.

fifty degrees. Extension professionals expected farmers to revise their techniques each year according to new research and guidelines.²⁷

Denitrification, the conversion of nitrogen to a soluble form, became a significant subject of warnings to farmers in the late 1960s. As one journalist informed his readers, the “risk of loss from fall application is smaller than once thought” because fall soil moisture was generally low. While he conceded that some nitrogen loss was possible, he emphasized that a gain of even one bushel per acre would offset a loss of up to one fourth of the total nitrogen applied per acre. As one farm journalist minimized the risk, another contended that fall application of nitrogen “got something of a black eye” in the 1967 growing season. Wet conditions in 1967 and 1969 highlighted the risks. Without naming sources, a writer for *Wallaces Farmer* stated that “concern” had been voiced that a hard winter in 1968-1969 depleted fall applied nitrogen through denitrification. Extension agronomists hesitated to state exactly why farmers had unsatisfactory results with their fall applied nitrogen. They insisted that fall nitrogen application could be accomplished successfully as long as the soil temperature was below fifty degrees Fahrenheit at a depth of four inches. Regis Voss, extension agronomist, maintained that anhydrous ammonia applied in the fall “stays pretty much in place.”²⁸

Neither experts nor farmers advocated abandoning fall fertilizing, but publicity of the risks during the late 1960s and raised awareness of the complexity of fertilizer use. The changing recommendations showed that expert advice as, much like the skill and knowledge

²⁷ “When should you apply your fertilizer?,” *Wallaces Farmer*, 6 October 1962; “Fall fertilizer application can boost 1965 yields,” *Wallaces Farmer*, 19 September 1964.

²⁸ Al Bull, “Apply nitrogen in the fall,” *Wallaces Farmer*, 10 September 1966; “Apply nitrogen this fall,” *Wallaces Farmer*, 14 October 1967; “Fall nitrogen program still safe, practical,” *Wallaces Farmer*, 11 October 1969; “Making the Most From Fall-Applied Anhydrous Ammonia For Corn,” Iowa State University Cooperative Extension Service, Ames, Iowa, *Pm-334*, August 1966.

of the farmer, was subject to change as experiments and experience revealed new information. By the end of the decade, fall fertilizing had become an established practice, but one that required more precision and knowledge to ensure that as much of the fertilizer as possible stayed in the ground to begin the next growing season.²⁹

The idea that fertilizer remained in the ground from one year to the next was an important one throughout the postwar period. Regardless of the application method, farmers and experts wanted to know how much chemical would remain in the ground available for the next crop year. The concept of carryover effects from fertilizer became public in 1952, when journalists cited an Iowa State College study of nitrogen fertilizer from test plots across the state. Heavy applications of plowed under nitrogen on corn ground (180 pounds per acre of 33.5-0-0) yielded increases from between two to thirty-nine bushels to the acre, reflecting differences in soil type and moisture. The virtues of carryover became a constant refrain as experts and farmers discussed fertilizer use. Iowa State College tests indicated that nitrogen carryover ranged from 5 to 50 percent of the previous year's application. In the early 1950s, experts calculated the carryover as the difference between the pounds of nitrogen applied per acre and the yield. For example, a farmer who applied 120 pounds of nitrogen per acre and had a corn yield of eighty bushels per acre could expect forty pounds of unused nitrogen per acre left behind.³⁰

²⁹ Norman West and Monte Sesker, "Special plowing and fertilizer considerations for this fall," *Wallaces Farmer*, 10 October 1970.

³⁰ A study of farmers in southern Iowa indicated that farmers who fertilized expected residual effects in the following year. Donald R. Kaldor and Earl O. Heady, "An Exploratory Study of Expectations, Uncertainty and Farm Plans in Southern Iowa Agriculture" Agricultural Experiment Station, Iowa State College, Ames, Iowa, *Research Bulletin 408*, April 1954, 877; "Nitrogen Helps Second Year," *Wallaces Farmer*, 15 March 1952; "Fertilizer Helps in Second Year," *Wallaces Farmer*, 5 December 1953.

By the early 1960s estimates of carryover were more sophisticated. Carryover was less linked to crop yield and more determined by soil type and rainfall. New calculations showed that farmers who used less than forty pounds of nitrogen per acre would not see much carryover, while those who used eighty to one hundred pounds of nitrogen per acre could expect to carryover twenty-five to thirty-five percent of the nitrogen, with higher levels of application resulting in a greater percentage of carryover. No one doubted that carryover could be an asset, but it was unclear just how valuable it would be.³¹

The idea of fertilizer carryover was especially significant in the mid 1950s as Iowa farmers struggled with drought across much of the state. When 1954 began with a dry spring, experts began to make the case for fertilizer. Lloyd Dumenil, Iowa State College fertilizer specialist, urged farmers to go ahead with their plans to use fertilizer, even if subsoil moisture was low. According to Dumenil, plants would run out of nitrogen in dry conditions. Extra nitrogen would allow those plants to survive a few days longer, which could be long enough to get rain. In extreme drought, plants would only utilize a little of the available nitrogen fertilizer leaving more in the ground to carryover for the next growing season. As a writer for *Wallaces' Farmer* put it, "If plants don't use the fertilizer this year, most of it will stay in the soil for the next crop." Fertilizer promoters emphasized that it was still economically worthwhile to fertilize, even though the gains might come in the next year.³²

In spite of the encouragement by fertilizer experts that applying fertilizer in dry years was profitable, Iowa farmers had their own ideas. After using a record 563,000 tons of commercial fertilizer in the state in 1954, farmers cut their usage in the dry years of 1954 and

³¹ "Fertilizer Use For Efficient Crop Production," Cooperative Extension Service, Iowa State University, Ames, Iowa, *Pamphlet 227* (Revised), March 1962; "Extra profit from fertilizer carryover," *Wallaces Farmer*, 15 February 1964.

³² "Fertilizer helps in dry years," *Wallaces Farmer*, 3 April 1954.

1955. In 1955 farmers reduced their fertilizer use by 55,000 tons. With fears of continued dry weather in 1956 and 1957 farmers adjusted fertilizer consumption accordingly, using just under 400,000 tons both years, representing a 20 percent drop from the 1954 high. One Clay County farmer reported using starter fertilizer and seventy-five pounds of anhydrous ammonia per acre on a dry portion of his farm in 1957. He found that his corn yielded only sixty bushels to the acre that year when it normally yielded eighty bushels. "I couldn't see much return from fertilizer," he observed. A county extension director concluded that the fertilizer cause "suffered a serious setback" during the drought of 1954 through 1956. Carl Peterson of Palo Alto County boosted his fertilizer use in 1955 over his 1953 and 1954 levels, perhaps following the lead of experts who said that fertilizer in dry years could pay. However, like many Iowa farmers, he scaled back in 1956. The next year he did not use any fertilizer for the first time since 1944. While it is unclear why he did so, his actions reflect the retreat from fertilizers from 1955 to 1957. Only the return of normal rainfall in 1958 prompted farmers to resume an aggressive program of fertilizer use. That year, farmers used almost as much commercial product as they did in 1954.³³

Fertilizer experts failed to convince Iowa farmers that fertilizer and carryover paid in drought years, but that did not stop them from mounting a rearguard defense of fertilizer use in dry years. In 1958 Al Bull of *Wallaces' Farmer* wrote about farmers who had good results from using fertilizer in the midst of drought. The story of Gerald Pederson from Clarke County indicates the tension over fertilizer use as well as the potential for profit. In 1957 Pedersen rented some land in addition to what he owned. The landlord did not want to

³³ *Second Biennial Report of Iowa Year Book of Agriculture* (Des Moines, State of Iowa, 1956); *Third Biennial Report of Iowa Year Book of Agriculture* (Des Moines, State of Iowa, 1956); "Iowa soil gets more fertilizer," *Wallaces Farmer*, 17 January 1959; "Use carryover to build up fertility," *Wallaces Farmer*, 1 March 1958. There is no farm record for Peterson in 1950. Peterson papers.

fertilize, but agreed that Pedersen could fertilize his half of the rented ground, presumably on the condition that the tenant would incur all expenses and reap all the benefit from any increased yield. Pederson applied starter fertilizer and side dressed with nitrogen. “All summer,” Pedersen noted, “you could see to the row where fertilizer had been applied. The landlord’s corn without fertilizer made forty-five to fifty bushels per acre. My corn went seventy to seventy-five bushels.” In Bull’s telling of the story, the parsimonious landlord lost and the innovative renter gained one third higher yields, suggesting that the farmer who stayed the chemical course would prevail. Most farmers disagreed, choosing to save their money for a year when the fertilizer might provide maximum return for the investment.³⁴

Drought was not the only circumstance which caused farmers to limit their fertilizer use. Up until the 1960s most experts and farmers considered applying nitrogen fertilizer to soybean fields as wasteful, in part because they believed that soybeans might benefit from any carryover fertilizer. The experts’ consensus was that soybeans did not respond to fertilizer as well as corn unless the land was especially low in potassium or phosphorous. Since fertilizer was one of the biggest expenses in making a crop, extension advisors counseled putting fertilizer first “on the high-value crop,” recognizing that on most Iowa farms corn was the most valuable crop. D. L. Armann, a farmer from Polk County, planted his soybean crop on land that had been in grass or legume hay. He reflected that he could “profitably fertilize corn but not beans so I let beans harvest sod nutrients.” Extension professionals and farm journalists discouraged farmers from fertilizing the bean crop into 1965, noting that the benefits of using fertilizer on soybeans did not outweigh the costs.³⁵

³⁴ Al Bull, “Fertilizer Keeps Corn Yields High,” *Wallaces Farmer*, 7 November 1958.

³⁵ “Fertilizer No Help To Beans,” *Des Moines Register*, 7 May 1950; “Fertilizers For Field Crops,” Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 112* (Revised), January 1947, 8; “Guide to

Farmers who fertilized soybeans challenged the experts' wisdom. Some farmers claimed that it was not worthwhile to fertilize soybeans but others disagreed. Alfred Accola of Polk County began using fertilizer on his soybeans in 1962 and obtained over sixty-three bushels per acre in a test plot. In 1966 growers who used fertilizer to obtain top soybean yields gained attention in the farm press. Furthermore, a 1967 survey of Iowa farmers who had grown high yielding soybean crops conducted by the National Soybean Improvement Council showed that fertilizer was an important part of successful soybean growers' techniques. Testimony from farmers proved the point. Roger Harms, a farmer from Butler County, entered a 1967 yield contest sponsored by American Cyanamid Company and applied 600 pounds of fertilizer per acre and produced eighty-five bushels to the acre on a five acre check plot, with seventy bushels to the acre on a fifteen acre field. Harms noted that he fertilized beans for the past five years and gradually increased the amount each year. While the fertilizer bill for 600 pounds per acre was high, the increased yields allowed him to net \$150 per acre on the five acre plot, more than offsetting his expenses for seed, fertilizer, herbicide, machinery, and labor.³⁶

The experts belatedly agreed that fertilizer could make a difference on the soybean crop, although none of them endorsed using the high levels of fertilizer that Harms did. One Iowa State University agronomist contended that fifty bushel to the acre soybean yields "are

Higher Soybean Yields," Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 202*, May 1953; "A Quick Guide for Higher Soybean Yields," Cooperative Extension Service, Iowa State University, *Pamphlet 290*, May 1962; "Cutting Costs in Today's Farming" Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 222*, February, 1956; Dick Albrecht, Growing soybeans," *Wallaces Farmer*, 2 May 1959; "How they get top soybean yields," *Wallaces Farmer*, 2 May 1964; "Apply fertilizer for your soybeans?," *Wallaces Farmer*, 4 May 1963; "How to shoot for top yields in 1965 soybeans," *Wallaces Farmer*, 1 May 1965.

³⁶ "How they get top soybean yields"; Al Bull, "Why aren't soybeans producing top yields?," *Wallaces Farmer*, 14 May 1966; "Top soybean growers interviewed," *Wallaces Farmer*, 13 May 1967; Monte Sesker, "85 bushel beans!," *Wallaces Farmer*, 11 November 1967.

common enough to indicate this may be a good goal to shoot for” and that fertilizer could help farmers reach that goal. The same type of crop management as farmers used for the corn crop could work for soybeans, too. In addition to planting soybeans in narrower rows, increasing the plant population per acre, fertilizer could play an important part of soybean management. While the Iowa State agronomist cautioned that soybeans would not show the same type of dramatic increases that corn showed, he recognized that not fertilizing beans “has been holding back yields.” In 1968 Iowa State soybean fertility specialist C. J. De Mooy noted that contrary to earlier beliefs, soybeans were a deep rooted plant, which meant that deep application of fertilizer could be useful to the plant later in the growing season when the root system was more fully developed. Other experts echoed this, arguing that fertilizer could increase yields enough to be profitable.³⁷

While it is difficult to know the degree to which farmers profited from using fertilizer on their corn, soybean, and forage crops, it is clear that they believed it helped. Farmers made it a regular part of their program within just a few years after the war. A poll of Iowa farmers from 1949 indicated that approximately 43 percent of farmers used fertilizer, most of them applying it to corn fields. In 1959 approximately 68 percent of farmers used fertilizer, even though less than half of farmers surveyed conducted soil tests to determine what kind of fertilizer they needed and how much to apply. A 1969 survey showed that 96 percent of Iowa farmers used fertilizer. Those who purchased and used commercial fertilizer were pleased with the results, with the exception of the 9 to 14 percent of farmers who reported no

³⁷ “Get higher yields from your soybeans,” *Wallaces Farmer*, 13 May 1967; Monte Sesker, “New approaches to fertilizing beans,” *Wallaces Farmer*, 25 May 1968; “How soybeans respond to fertilizer,” *Wallaces Farmer*, 10 February 1968.

effect from their fertilizer during the drought years of 1954 and 1955. This short period of drought was only a temporary reverse for fertilizer use.³⁸

Farm records from the time period provide a closer look at the general pattern of commercial fertilizer consumption. Farmers who began farming in the 1930s were less aggressive about their fertilizer use. Carl and Bertha Peterson of Palo Alto County began purchasing phosphate in 1945 and continued to buy one or two tons per year, spending an average of \$64 per year from 1945 to 1951. The Peterson's made a major commitment to fertilizer in the years from 1952 to 1956. They purchased high analysis fertilizer with a high phosphorous content almost every spring, starter fertilizer for corn containing the insecticide aldrin, and occasionally applied fertilizer in the fall. They used approximately the same type and amount of commercial product every year, applying 5-20-20 and 5-20-10 starter fertilizer every year from 1954 to 1966. In the following years the records are less precise in terms of what kind of product they used. At the end of the 1960s, however, they purchased approximately the same amount of product as they previously did with some variations in timing and composition, although the fertilizer was more expensive than it had been in the earlier years. In 1967, 1969 and 1970 their fertilizer bill totaled over \$300 each year. The increasing costs the Peterson's paid were not due to increasing use, but to cost increases.³⁹

The Peterson's were the exception to the rule of increasing fertilizer use. Most Iowa farmers used more commercial fertilizer in hopes of obtaining bigger yields. In the 1960s Iowa farmers doubled the amount of nitrogen they used per acre, from forty-five pounds per

³⁸ "43 Pct. Of Farmers Use Fertilizer," *Wallaces Farmer*, 1 October 1949; "Iowa soil gets more fertilizer," *Wallaces Farmer*, 17 January 1959; "Did you test your soil?," *Wallaces Farmer*, 18 May 1957; *Al Bull*, "Farmers will use more fertilizer on corn in '69," *Wallaces Farmer*, 8 March 1969; "Corn fertilizer paid off," *Wallaces Farmer*, 7 April 1956.

³⁹ Peterson papers.

acre in 1964 to 104.3 per acre in 1969. This type of growth was in line with the increases in application rates in other Midwestern states. Minnesota farmers nearly tripled their application and Illinois farmers increased their rate by over one third. Farmers who harvested the largest corn crops used the most fertilizer. A farmer from Northeast Iowa who had a 125 bushel per acre crop stated that his neighbors could have obtained similar yields “if they’d use enough fertilizer.” Extension professionals urged farmers who wanted to raise corn that yielded from 100 to 120 bushels to the acre to use from 120 to 150 pounds of nitrogen and a maximum of thirty-seven pounds of phosphorous and sixty-five pounds of potassium on each acre. Rudolf Schipull of Wright County increased his fertilizer use in the late 1960s. From 1963 to 1965 he applied an average of seventeen tons of fertilizer each year on the two farms he operated. From 1966 to 1970, however, he applied an average of twenty-nine tons per year on those two farms. As farmers used more fertilizer per acre over the course of the 1950s and 1960s, fertilizer became the leading crop expense, accounting for 24 percent of total costs of raising the corn crop calculated on a per acre basis in 1958 and 39 percent in 1967.⁴⁰

⁴⁰ “Fertilizer is big factor in high corn yields,” *Wallaces Farmer*, 24 February 1968; Bull, “Farmers will use more fertilizer on corn in ’69”; “Fertilizer use has doubled in 6 years,” *Wallaces Farmer*, 28 February 1970; “Fertilizer made the difference,” *Wallaces Farmer*, 18 January 1964; “Profitable Corn Production,” Cooperative Extension Service, Iowa State University, Ames, Iowa, *Pamphlet 409*, January 1968. In a 1973 study of prices of nitrogen fertilizer in Illinois, one scholar detailed the significant price decline for nitrogen fertilizer in the years after 1950, dropping from a high of \$.18 per pound in 1949 to \$.06 per pound in 1970. See Jeffrey Finke, “Nitrogen Fertilizer: Price Levels and Sales in Illinois, 1945-1971,” *Illinois Agricultural Economics*, 13 (January 1973): 35-36. North Dakota farmers also experienced a similar increase in fertilizer expense, even as prices were falling. According to one study of North Dakota agriculture, fertilizer and lime was the fastest growing operating expense on farms in that state from 1949 to 1965. Fred R. Taylor, “North Dakota Agriculture Since World War II,” *North Dakota History* 34 (April 1967): 56; Schipull papers. For fertilizer costs as a percent of raising the corn crop see “Corn growing costs run high!,” *Wallaces Farmer*, 19 April 1958 and Ken Hofmeyer, “What does it cost to grow good corn?,” *Wallaces Farmer*, 9 September 1967.

Critics outside of agriculture pointed out that there were costs associated with fertilizers other than just financial ones. Just as public concern mounted over the consequences of DDT use, the idea that fertilizers could be harmful gained momentum in the 1960s. While Rachel Carson's *Silent Spring* was an attack on the indiscriminate use of pesticides, the implications for discussions of water quality were clear. In Carson's view, farmers, led by the USDA and chemical manufacturers, used chemicals in such a way as to threaten the survival of wildlife and people. Carson attacked those who would control or subjugate nature with chemicals, singling out scientists and bureaucrats at the USDA's Agricultural Research Service for special criticism. As historians have noted, Carson's indictment found a receptive audience in the middle class during an era when people perceived many parts of the environment toxic, from nuclear fallout to septic tanks in housing developments to pesticides on suburban lawns. In 1965 Congress passed the Water Quality Act, which authorized the Secretary of Health, Education, and Welfare to formulate water quality standards for states in the absence of state action. The 1965 Act, more so than previous federal legislation, put water quality on the national agenda by giving the federal government authority to act on behalf of the states.⁴¹

In Iowa, there were signs that fertilizer runoff was becoming a problem for public health in the 1960s. Water samples submitted to the state hygienic laboratory from private and rural water supplies showed high levels of nitrate ion concentrations. High levels of

⁴¹ Hal Rothman, *Saving the Planet: The American Response to the Environment in the Twentieth Century* (Chicago: Ivan R. Dee, Inc., 2000), 113, 126. Samuel P. Hays provided an in-depth look at the many threats to the environment people perceived in the 1960s and 1970s. *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985* (Cambridge: Cambridge University Press, 1989), 162-164. For specific information on the federal water quality legislation of the 1950s and 1960s see N. William Hines, *Nor Any Drop to Drink: Public Regulation of Water Quality* (Iowa City, Iowa: Agricultural Law Center, College of Law, University of Iowa, September, 1967), 799-859.

nitrate in the water were new in the 1960s, but there was a difference in the type of wells sampled. By the 1960s, there were fewer shallow, hand dug wells in use as Iowans had invested in new, deep wells. Many of these deep wells, however, had the same high levels of nitrates as the old style wells, suggesting that the contamination problem was severe. While experts were cautious not to attribute high nitrate levels to the increasing use of nitrogen fertilizer since 1945, fertilizer was likely the principal reason for current levels of nitrates in well water.⁴²

Few Iowa farmers expressed much concern about risks of fertilizer runoff and the environmental costs of fertilizer use, but there was a sense among farmers, journalists, and agricultural scientists that public criticism and pressure could potentially force Congress or state legislatures to act in ways that would impede farmers' ability to make a living. Seeley Lodwick of Lee County was one of the few farmers who publicly expressed concern about the effects of pollution on farm practices. In 1968 Lodwick, president of the American Soybean Association, editorialized that "Even tho [sic] these pollution control laws are not fully enforced today, we have every reason to expect mounting pressure for clean, fresh water from the eighty percent of our population who live in the cities of Iowa. These laws," he argued, "will someday---soon---be enforced." In 1970 Al Bull of *Wallaces Farmer* asked "Are fertilizers polluting our streams?" His answer was equivocal, reflecting the recognition by agricultural scientists that too much nitrogen runoff could be a problem and that there was evidence of nitrate contamination of water supplies. Bull quoted Regis Voss of Iowa State University, who conceded "I'd certainly not say that fertilizer isn't contributing to nitrate

⁴² Robert L. Morris and Lauren G. Johnson, "Pollution Problems in Iowa" in *Water Resources of Iowa*, ed. Paul J. Horick (Iowa City, Iowa: University Printing Service, January, 1970), 92-97.

content of surface waters.” Voss and the other scientists refused to blame farmers who used nitrogen fertilizer according to recommendations, but acknowledged that farmers who applied nitrogen improperly or excessively contributed to pollution problems. Experts argued that fertilizer actually helped reduce pollution by preserving organic matter in soils and preventing erosion. While Bull and the experts understood that nitrogen fertilizers could be pollutants, Bull believed that the real problem was “unrealistic ecologists” who had “visions of crystal clear streams” that he argued were never part of prairie ecosystems. If ignorant outsiders placed restrictions on farm fertilizer based on unrealistic assumptions then farm profits would be threatened. The best result farmers could hope for was to keep idealistic scientists and the public from pressuring lawmakers into enacting “unreasonable restrictions” on nitrogen use.⁴³

In the early 1970s ecologists and concerned citizens, however, had the clout to change the nation’s laws regarding water quality. As noted, many middle class people in and out of government saw the environment as toxic and blamed technological progress. Activists such as Barry Commoner testified about the nitrate levels in neighboring Illinois streams while state pollution control boards across the nation focused attention on nitrates, soil erosion, and threats to wildlife through loss of habitat and chemical poisoning. In 1972 Congress followed the 1965 Water Quality Act with the Federal Water Pollution Control Act, known as the Clean Water Act, in an effort to preserve the “chemical, physical, and biological integrity of the nation’s waters.” The authors of the Clean Water Act focused on pollution from point sources such as factories and had little effect on farmers, but the rules

⁴³ Seeley Lodwick, “Farmers must control water pollution,” *Wallaces Farmer*, 27 July 1968; Al Bull, “Are fertilizers polluting our streams?,” *Wallaces Farmer*, 23 May 1970; Ralph Sanders, “Pollution--Your Problem, Too,” *Successful Farming*, 1971 *Crop Planning Issue*, November 1970.

for chemical fertilizer use were under scrutiny from outsiders and non-farm related interest groups for the first time. The state of Iowa's Chemical Technology Review Board (created in 1970) considered it important to study the movement of agricultural chemicals into surface or ground waters but did not recommend any legislative action in 1970. Farmers would not have to change their practices in 1970, but the Iowa legislature and Congress recognized the legitimacy of the concept of ecosystems which would change the approach of scientists, policy makers, and farmers in the coming years.⁴⁴

In the years up to 1972, most Iowa farmers who discussed fertilizer talked about potential yield gains, expenses, and methods or timing of application, not ecological costs or environmental damage. There is little public record of any farmers expressing concern about fertilizer runoff and pollution of ground or surface water. For most farmers, chemical fertilizers, especially nitrogen in the form of anhydrous ammonia, helped them boost profits. While there were farmers who recognized that fertilizers could be harmful to themselves and others, they had little evidence that fertilizer technology was bad for them or their land. They understood that experts and innovative farmers told the truth when they claimed that fertilizers increased yields and offset any financial costs. Fertilizer gave the land a kick to increase production. The change in commercial fertilizer use from 182,651 tons in 1946 to 2,648,196 tons in 1970 was a demonstration of the confidence the majority of farmers had in fertilizer technology. In 1971 Iowa farmers used fertilizer on 95 percent of all corn acres in the state. They timed applications on crops, especially cornfields, according to their other

⁴⁴ Adam Rome described the rise of American environmental consciousness as it related to urban issues in *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism* (Cambridge: Cambridge University Press, 2001). C. Robert Taylor, "An Analysis of Nitrate Concentrations in Illinois Streams" *Illinois Agricultural Economics*, 13 (January 1973): 12; *Tenth Biennial Report of Iowa Book of Agriculture, 1970-1971*, 84-86.

labor demands, cut their fertilizer use during drought conditions in spite of expert advice to the contrary, and rejected expert advice that using fertilizer on soybean fields did not pay. As the 1960s ended, it was becoming clear that fertilizer could also give the land and even Iowa's water a kick in a negative sense. In the years to come, farmers and agricultural experts would be aware that fertilizer use required just as much caution as pesticides.⁴⁵

⁴⁵ "Iowa fertilizer use climbs," *Wallaces Farmer*, 27 February 1971.

CHAPTER FOUR

Feeding Chemicals

Two new kinds of powerful drugs came into use on farms in Iowa and across the United States after World War II: antibiotics and growth hormones. Farmers could use antibiotics to control outbreaks of disease, but they also had another application. Animals that consumed feed mixed with antibiotics or hormones reached market weight with less feed. Since feed costs represented a large portion of the total cost of raising an animal from birth to market, any innovation that could maximize production while cutting costs very attractive to farmers who lived through the years of the cost-price squeeze and increasing labor costs.

The story of the scientific development of antibiotics and growth hormones is a familiar one. In the 1940s, scientists recognized that B₁₂ had growth stimulating properties when used in livestock feed. They called the new vitamin mix Animal Protein Factor, or A.P.F. Farmers who used A.P.F. not only found that their hogs gained weight 10 to 20 percent faster than animals without it, the substance also prevented a common disease called swine dysentery, also known as bloody scours. In 1949, however, E. L. R. Stokstad and T. H. Jukes discovered that only B₁₂ that had been produced as a byproduct of antibiotic manufacturing possessed this quality. The residue, they concluded, not the vitamin itself, was the ingredient in A.P.F. that actually stimulated growth. In 1950, feed manufacturers began adding several kinds of antibiotics to feed, including Aureomycin and streptomycin.¹

¹ For an overview of the development of feed additives, see Terry G. Summons, "Animal Feed Additives, 1940-1966," *Agricultural History* 42 (October 1968): 305-313. Sidney W. Fox, "What are antibiotics?," *Iowa Farm Science* 7 (October 1952); J. S. Russell, "Credits I.S.C. Discovery on Growth Drug," *Des Moines Sunday Register*, 14 May 1950; Wally Inman, "Help Spring Pigs To Catch Up," *Wallaces Farmer*, 5 May 1951; "Pigs to Market Weeks Sooner," *Wallaces Farmer*, 20 October 1951.

Researchers used the growth hormone diethylstilbestrol (hereafter DES or stilbestrol), a synthetic form of estrogen, in dairy research during World War II to return dry milk cows to production to meet high wartime demands for dairy products. In 1951 Wise Burroughs, a scientist at Iowa State College, observed that lambs fed with hormone-laced feed gained weight faster than those on a normal ration. In 1954, based on research by Burroughs and others at Iowa State, feed manufacturers incorporated stilbestrol into feeds for cattle. Cattle were a natural choice for the commercial introduction of this substance, since Americans consumed far more beef than mutton. In the heart of the Corn Belt, where sales of hogs and cattle accounted for the largest share of farm income, antibiotics and growth hormones were big news.²

Although the stories of scientific research and development of antibiotics and hormones are familiar, the story of how farmers came to use these chemicals for livestock is more obscure. Farmers were interested in the new drugs, although they were unavailable in the 1940s. In 1946 farmers learned that penicillin had the potential to “save” cows by allowing animals that suffered from mastitis, an infection of the udder that slowed or stopped milk production, to return to full production. Farm journalists observed that when the news of hormone feeding became public, there was excitement that a little supplement would enable farmers to increase production, but as of 1946 hormones were not commercially available. Tests conducted at Purdue University in 1947 and 1948 indicated that a pellet of stilbestrol could be injected under the skin of a heifer to promote rapid weight gain. Before

² Truman Henley, “New Drug---Big Future,” *Successful Farming*, March 1944.

growth hormones for cattle were on the market, feed manufacturers introduced the new, post A.P.F. antibiotic feeds.³

Journalists and scientists labeled antibiotics “wonder drugs,” capable of solving the problem of high infant mortality among hogs and also speeding the growth of feeder pigs destined for market. Tests conducted at Experiment Stations and labs around the country indicated that hogs and other animals benefited from ration laced with antibiotics. A writer for *Wallaces' Farmer* reported that tests at the Hormel Institute farms in Minnesota indicated that runty pigs fed with Aureomycin mixed into the feed could catch-up with healthy pigs. Furthermore, healthy pigs that received feed with antibiotics would grow twice as fast as pigs on a normal ration. Damon Catron and his Iowa State College colleague claimed that this was “New Hope for 20 million runts” across the United States, since one pig out of every litter was abnormally small or unhealthy. They explained that farmers who used antibiotics could expect “faster gains, more pork from 100 pounds of feed, and less trouble from scours.” By feeding five milligrams of Aureomycin per pound of feed farmers could produce one hundred pounds of pork with 349 pounds of feed instead of 369 pounds.⁴

Advertisers promptly featured the growth enhancing properties of antibiotics with testimonials from farmers. In 1952 the Pfizer Company touted the remarkable gains a farmer from eastern Iowa obtained by adding Terramycin to his hog rations. He marketed 206 pound hogs when they were 139 days old. These animals consumed 3.4 pounds of feed for

³ R. Allen Packer, “Penicillin is saving cows,” *Successful Farming*, November 1946; C. E. Hughes, “Latest Roundup on Hormone Feeding,” *Successful Farming*, October 1946; Hormones for Milk,” *Wallaces Farmer*, 3 July 1948; “Sex Hormone Makes Heifers Get Fat,” *Wallaces Farmer*, 5 March 1949.

⁴ “Antibiotics,” *Successful Farming*, March 1951; “What’s Lowdown on Aureomycin?,” *Wallaces Farmer*, 7 June 1950; Vernon Vine and Claude W. Gifford, “APF gives up some secrets,” *Farm Journal*, June 1950; Damon Catron and Dean Wolf, “New Hope for 20 million runts,” *Successful Farming*, March 1951; Wolf, “Latest on wonder drugs in feeds: What they do for hogs,” *Successful Farming*, April 1951; Homer Hush, “Makes Hogs of Runts,” *Wallaces Farmer*, 5 May 1951.

every one pound of weight gain, costing 14.8 cents per pound of pork produced. The following year another Pfizer advertisement provided context for those numbers. Pfizer claimed that fifty pound hogs with Terramycin in their ration reached market weight in ninety-four days, compared to 111 days for hogs without the enriched ration. Using antibiotics enabled farmers to reduce the number of days on feed, thereby saving at least ten percent of feed costs.⁵

Farmers read the news and wanted the drugs. In 1950 farmers inquired about the mysterious A.P.F. Hundreds of farmers sent postcards and letters to Damon Catron and Iowa State to obtain information and even the actual medication. The following exchange was typical of the correspondence farmers and Catron carried on in 1950 and 1951. “Dear Sirs: I am a young hog raiser up hear [sic] at Iowa Falls and am interested in learning all I can about getting some off the new wonder drug “aureomycin.” Can you inform me as to what I can best do to get some? Also how should I feed it.” Catron responded that the wonder drug status was prematurely bestowed on Aureomycin. Even so, he noted that pure antibiotics were only available by prescription. Only certain A.P.F. concentrates contained the antibiotic residues, and as of mid 1950 there was no way to get the drugs.⁶

The inquiries continued in 1951. The Wright County Extension Director wrote to Catron in April, 1951 as the news of antibiotics broke across the nation. He reported that area dairy farmers fed skim milk to their hogs as a supplement to grain and that they wondered how to get antibiotics into the milk. Catron assured him that it as possible to combine the commercially available antibiotic-vitamin premix with skim milk, since the

⁵ Pfizer Advertisement, *Wallaces Farmer*, October 18, 1952; Pfizer Advertisement, *Wallaces Farmer*, 20 June 1953.

⁶ Max Bartlett to Damon Catron, n.d., Damon Catron to Max Bartlett, 15 June 1950, Damon Catron Papers, Special Collections, Parks Library, Iowa State University.

antibiotics and the vitamins were all water soluble. Several farmers who attended a local Wright County swine meeting also wanted the updated formula for swine rations to take advantage of the latest feeding developments.⁷

When farmers actually used antibiotics the results were sometimes unsatisfactory. In 1951 a farmer from Woodbury County complained that he used commercial feed that contained vitamin B₁₂ and antibiotics but his herd of hogs still presented symptoms of bacterial infection and nutritional deficiencies such as scouring, or diarrhea. Similarly, a Polk County farmer who had a history of swine dysentery in his herd reflected that “I thought the antibiotics I’ve been feeding would control this.” The problem for both of these farmers was that the antibiotic laced rations they were feeding could not overcome an inherent problem in farm management. Many farmers used the same hog lots year after year. This provided an ideal environment for parasites and bacteria that made animals die, become sick or, at the very least, slowed their growth.⁸

Extension directors and Iowa State College faculty urged farmers not to use antibiotics as a substitute for good management. As the experiences of the two hog raisers from Woodbury and Polk Counties indicated, farmers had to do more than simply provide feed with antibiotics. Rotating animals through different lots from year to year was an ideal solution, since it prevented the build up of dangerous pathogens in the soil. Other solutions included cleaning and disinfecting hog houses and shelters. For those who wanted to use drugs, it was important to adjust the dosage to meet the specific needs of a farmer’s herd.

⁷ Aaron R. Bowman to Damon Catron, 23 April 1951 and Catron to Bowman, 19 May 1951, Catron Papers.

⁸ “Drugs Can’t Whip Old Lots,” *Wallaces Farmer*, 18 August 1951.

Damon Catron noted that different quantities of B₁₂ and antibiotics were needed for healthy animals than for sickly ones.⁹

Some farmers experimented with injecting antibiotic pellets into hogs. By implanting a pellet of Bacitracin under the skin behind the ear of pigs when they were just two days old, the animal would get the growth promoting benefit of the antibiotic while it was still nursing its mother. Victor Nicolet of Cerro Gordo County injected antibiotic pellets into his pigs in the fall of 1952. When he moved to a new farm in the spring of 1952, he only weaned sixty-four of the seventy-two pigs he farrowed. This loss of over ten percent of his pigs was bad news, but the bad news continued. His surviving pigs gained weight slowly throughout the year. Nicolet learned the hard way that the hog lots on his new farm were infested with disease. After injecting his pigs with the pellets, Nicolet used the same rations and lots and had much better luck with his rate of gain and herd health. While he did not leave any pigs untreated as a control, he believed that the treatment made a difference. So, too, did his brother and father who injected their pigs in 1953 based on Victor's experiment. "The cost is low," he claimed, "So the treatment doesn't have to do much good to be worth more than it costs." Injecting antibiotic pellets, however, was more work than feeding commercially prepared feeds with antibiotics included in the ingredients. Feeding became the most common delivery system for antibiotics.¹⁰

Antibiotics played an ever more important part in the changing nature of hog production in the 1950s. Experts and farmers attempted to get hogs to market faster and spread the marketing of hogs throughout the year rather than during the fall and winter.

⁹ "Drugs Can't Whip Old Lots."

¹⁰ Homer Hush, "Shoot Antibiotic Into Pigs," *Wallaces Farmer*, 21 June 1952; "Inject Antibiotics Into Pigs?," *Wallaces Farmer*, 7 March 1953.

Antibiotics were valuable in making the transition to earlier weaning of pigs. Farmers who raised hogs had traditionally weaned pigs at approximately eight weeks of age, relying on the sows to provide the calories, nutrients, and antibodies while the young animals gradually learned to consume grain or forage. At weaning time, some farmers provided starter feed that often included molasses or other sweeteners to help the young pigs. In the 1950s Catron and other experts promoted the replacement of milk from the sow with carefully balanced feeds that enabled young pigs to grow faster, prevent sows from losing weight through the lactation period, and permitted sows to reproduce sooner. Early experiments focused on the use of synthetic milk that included antibiotics, but there were problems with getting the milk to the pigs. The liquid required careful mixing, it was easily wasted through spillage, and easily frozen in cold weather.

Beginning in 1954 experts at Iowa State College introduced a new feed ration to aid with early weaning called a “pre-starter.” It was a transition feed to get week old pigs from sow’s milk to starter feed. Labeled I.S.C. Pre-starter “75,” the formula included antibiotics just like the synthetic milk, but this new feed was in dry form which was easier to handle and feed. The promoters of pre-starter argued that it cost \$6.29 to feed the one pig and the mother for eight weeks and only \$5.47 to feed the pig for eight weeks and its mother for two weeks. The cost savings of \$.82 multiplied by dozens or even hundreds of pigs per year amounted to hundreds of dollars that the farmer could realize by early weaning. Catron and other swine nutritionists cautioned that this practice was not for every hog producer. Farmers

who were committed to a high degree of management in sanitation, housing, and feeding were best suited to early weaning.¹¹

Farmers flooded Damon Catron with questions about “Pre-starter 75,” subsequent revised formulas, and new mixes that included antibiotics such as “Plus” and “3-Nitro.” Hundreds of inquiries arrived from across the state and from around the United States from individual farmers, county extension directors, and farm managers for Farmers National Company and Doane Agricultural Service. Catron provided copies of the ration formula for farmers to mix themselves or to provide to local feed millers. Catron encouraged farmers to purchase feed from reputable dealers such as the Carroll Swanson Company located in Des Moines. He stressed to all of his correspondents that specially formulated swine rations with antibiotics for each stage of the life cycle were the best way to produce gains for the least possible cost per pound.¹²

Farmers who wanted to either increase hog production or to farrow and market hogs throughout the year were the first people interested in early weaning. Lester Heimstra of Cherokee County weaned 500 pigs at four weeks of age in 1954. At weaning time, Heimstra separated his pigs into pens of twelve to fourteen animals and kept them on a pre-starter feed for ten days until they were ready for starter feed. At eight weeks the pigs were ready for the growing-fattening ration that they would consume for the next three months until they were ready to market. Other farmers testified to the success of early weaning, but just like the

¹¹ “Wean ‘em early?,” *Wallaces Farmer*, 5 March 1955; Vaughn Speer, Gordon Ashton, Francis Diaz, and Damon Catron, “New I.S.C. Pre-Starter ‘75’,” *Iowa Farm Science* 8 (April 1954).

¹² Jack D. Waite to Damon Catron, April 20, 1954, Catron to Waite, May 6, 1954; Eugene Fitz to Damon Catron, March 27, 1955, Catron to Fitz, April 8, 1955; Wilburt H. Frye to Damon Catron, December 29, 1955, Catron to Frye, January 6, 1956; Don Buckley to Damon Catron, 12 January 1956, Catron to Buckley, February 13, 1956, Catron Papers.

experts, they urged farmers who were interested in trying it to practice good sanitation and to provide an adequate supply of clean water. Most farmers were not interested in weaning as early as the experts recommended, however. One farmer stated that he believed in “letting pigs get their milk nature’s way for six weeks.” A 1955 poll indicated that only 7.3 percent of farmers weaned pigs at four weeks or earlier, while 89.5 percent weaned at six weeks or later. The big change in weaning could be discerned by looking at the numbers a different way. Forty-two percent of farmers were weaning sooner than eight weeks, cutting the traditional weaning time of eight weeks. Farmers who tried early weaning found that it was more profitable than waiting. A Lee County farmer asserted that the pigs he weaned at three weeks gained better than the ones he weaned at six weeks of age. This trend in weaning was not possible without the presence of growth enhancing and disease fighting antibiotics.¹³

As hog rations and feeding practices became more exacting and complicated in the mid 1950s, DES was commercially available. Experts explained that the long gap between the first publicity of stilbestrol and the actual introduction was so long because of time needed to obtain test results on the effects of hormone feeding on the animals. The United States FDA wanted to ensure that there was no danger to meat consumers. Since obtaining consistent results with hormones was difficult, even in laboratories and on experimental farms, one author concluded in 1952 that “we can’t expect better results under farm conditions and in the hands of nonspecialists.” While there was the potential for danger to consumers, the consensus among scientists was that only consuming abnormally large quantities of meat, especially liver, posed any risk. In 1954, over a decade after the first

¹³ “They’re weaning earlier,” *Wallaces Farmer*, 19 March 1955; “Wean pigs at what age?,” *Wallaces Farmer*, 18 August 1956; “When to wean the pigs,” *Wallaces Farmer*, 7 September 1957.

publicity about DES, the FDA authorized the commercial manufacture and sale of the hormone.¹⁴

The Iowa State College Cooperative Extension Service released a new pamphlet about adding stilbestrol to beef cattle feeds in November, 1954. The authors, Wise Burroughs and C. C. Culbertson of the Iowa Agricultural Experiment Station and William Zmolek, extension animal husbandry specialist, described stilbestrol and provided guidelines for proper use. The authors informed farmers that they could reduce feed costs from 10 to 20 percent, or approximately \$.02 to \$.04 per pound of live weight. There were also several caveats emphasized in italics throughout the document. Stilbestrol was not to be fed to dairy cattle or breeding animals, feeding higher than recommended levels should not be attempted, and that mishandled stilbestrol could be dangerous to people. The authors emphasized that the bottom line for farmers considering stilbestrol use was the difference between costs and return on investment. Feed supplements containing stilbestrol cost between five and ten dollars per ton more than supplements without stilbestrol. Depending on the cost, farmers could expect a return of from approximately \$10 to \$19 for every dollar spent on stilbestrol.¹⁵

A large number of farmers tried stilbestrol almost immediately after its introduction and most of them liked it. Forty days after stilbestrol was on the market, approximately 20 percent of Iowa cattle feeders used it. The fact that only half of all farmers raised cattle for commercial sale did not diminish the remarkable nature of this adoption. By the summer of 1955, 28 percent of cattle feeders used feeds prepared with stilbestrol. Ample positive

¹⁴ A. V. Nalbandov, Hormones---what they will and won't do for livestock," *Successful Farming*, November 1952; Robert G. Rupp, "'Hurry-Up' Hormone for Feeder Cattle," *The Farmer's Digest* 18 (June-July 1954).

¹⁵ "Questions and Answers About Adding Stilbestrol to Feeds for Growing and Fattening Beef Cattle," Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 215*, November 1954; Summons, "Animal Feed Additives," 310.

publicity helped ease the way for farmers to use the hormone. 4-H leaders sponsored contests for young people who could raise cattle with the fastest gains. Farmers who used it gave favorable reports, although farm record keeping was not up to the standards of experiment stations or laboratories. Max Clowes of Humboldt County claimed “I think stilbestrol did me some good, but I can’t prove it. I handled cattle a little differently this year---didn’t use as much pasture.” Without a control group, Clowes and farmers could not make conclusive claims about their experiences. Other farmers had better basis for making judgments. Ed Hibbs of Pocahontas County found that his steers gained three pounds per day over 163 days with stilbestrol. Hibbs quit feeding stilbestrol thirty days before marketing because he heard a rumor that stilbestrol-fed cattle did not dress out at the packing plant as well as cattle on traditional rations. He regretted this move, however, since the rate of gain for his cattle slowed in those last thirty days. Practical experience with stilbestrol convinced farmers that it was not only worth trying but incorporating into their feed program.¹⁶

Nine years after the introduction stilbestrol, Zmolek and Burroughs collaborated to produce an updated guide to the use of stilbestrol. The most significant difference between the 1954 bulletin and the 1963 version was the degree of complexity, most readily apparent in the title of the new publication, “62 Questions About Stilbestrol Answered.” Incorporating years of continued research and reports from farmers, the authors repeated some of the basics, but the new version included less cautionary language, with no warnings in italics. They reminded farmers not to feed stilbestrol to breeding animals and that the only

¹⁶ “Feed steers gain-booster,” *Wallaces Farmer*, 19 February 1955; Cliff Johnson interview; “Feed stilbestrol,” *Wallaces Farmer*, 15 October 1955; “Stilbestrol---how’s it doing?,” *Wallaces Farmer*, 5 November 1955.

residue was found in visceral organs, not meat or fat. As long as farmers observed a forty-eight hour withdrawal period before slaughter, the trace amount of DES in the liver and other organs was no longer detectable. The “62 Questions” bulletin reflected experts’ and farmers’ optimism about the benefits of feeding stilbestrol.¹⁷

In the late 1950s, however, there were warnings of potential trouble for farmers who used feeds that contained antibiotics and stilbestrol. The first was in September, 1958 when President Eisenhower signed into law the Food Additive Amendment to the 1938 Food, Drug, and Cosmetics Act. The 1958 amendment included the Delaney clause, which stated that no food additive could be considered safe if it was a known carcinogen in humans or animals. Researchers knew that DES was a cancer-causing agent when administered in large doses to laboratory mice, although tests on other animals, including cattle, did not indicate a link between DES and cancer. The FDA concluded that medicated livestock feed amounted to a food additive, which put authority over feed additives such as stilbestrol under FDA regulation. Previously approved substances such as stilbestrol remained on the market as part of a compromise for agriculture and the pharmaceutical industry. Stilbestrol remained part of the feeding program for many Iowa families that raised cattle, but it had been a scare for farmers who feared that increasing feed costs threatened already small profits.¹⁸

Months after the enactment of the Delaney clause and the FDA ruling on medicated feeds, farmers learned of another warning about drugs in agriculture. This time the warning was from agricultural experts rather than Congressmen. In 1959 the Animal Health Institute

¹⁷ “62 Questions About Stilbestrol Answered,” Agricultural and Home Economics Experiment Station, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa, *Bulletin P-133*, July 1963.

¹⁸ For an extended discussion of the public debate over DES in Congress, the Courts, and the media, see Marcus, *Cancer From Beef*.

and the American Feed Manufacturers issued a joint statement regarding the use of commercial medicated feeds. These groups recognized that medicated feeds enabled farmers to realize significant increases in production at reduced costs, which made farm products more affordable for consumers. However, “these [medicated] feeds never were designed to be a substitute for sound management and sanitation.” According to the two groups, everyone involved in the livestock business, from manufacturers, dealers, and salesmen to farmers needed to understand that good management was an essential part of the success of medicated feeds.¹⁹

The significance of the threatened status of farm chemicals and the expanded role of the federal government was apparent in the highly publicized incident over the use of a pesticide in cranberry cultivation that was a suspected carcinogen. Just before Thanksgiving in 1959, Secretary of Health, Education, and Welfare Arthur Flemming urged consumers to avoid cranberries because of the presence of that chemical on harvested fruit. In the aftermath of the cranberry incident, the editors of *Wallaces' Farmer* noted that the federal government was preparing to “clamp down” on farm chemicals. According to *Wallaces' Farmer* writers, the FDA was prepared to increase efforts to enforce the ban on antibiotic residues in milk. Farmers, they suggested, faced a more adversarial relationship with the federal government over the issue of farm chemicals.

There was also news that the chemicals farmers depended on had problems. It appeared that antibiotics were less effective in promoting growth in livestock than they had been. Over the course of the 1950s farmers observed that flies that survived DDT attacks bred new generations that were less susceptible to DDT and other chlorinated hydrocarbon

¹⁹ “Drugs Won’t Replace Good Livestock Management!,” *Wallaces Farmer*, 2 May 1959.

insecticides. Now they learned that their wonder drugs were losing effectiveness. Damon Catron suggested that there were several potential explanations for this development. It was possible that there was an increase in populations of organisms that were not harmed by antibiotics or even resistant bacteria. Catron did not specify any one as the most likely explanation, but he recommended that farmers use different combinations of antibiotics to prevent declines in effectiveness. The combination of broad spectrum antibiotics and good sanitation practices was the experts' ideal.²⁰

After the furor of 1959, no news about feed additives was good news for Iowa farmers. The reprieve from government action let farmers conduct their business in ways that suited them. They continued to rely on feeds with antibiotics for hog production and stilbestrol for beef production. A minority of hog farmers experimented with new strategies in raising hogs which made sub therapeutic antibiotics even more important. One of the new strategies was to confine hogs on concrete lots with specified rations rather than turning them out on pasture and supplementing their diet with corn (see chapter five). Placing larger numbers of animals in close quarters created an ideal disease environment. Antibiotics in feed accelerated weight gain in those hogs but also helped to prevent outbreaks of disease. By the 1960s, farmers confined hogs inside buildings to minimize environmental stresses such as temperature change. Some farmers even raised hogs indoors from birth to marketing, known as "life cycle housing" from farrowing to finishing. Feed additives were more important than ever by the mid 1960s.²¹

²⁰ "Get good results from antibiotics," *Wallaces Farmer*, 21 March 1959.

²¹ See Finlay, "Hogs, Antibiotics, and the Industrial Environments of Postwar Agriculture."

The quiet over the issue of feed additives did not last. By the late 1960s feed additives were in the news again. On April 1, 1968, the FDA announced that several antibiotics of choice would be restricted for livestock production in sixty days if there were no “sufficient objections” raised during that time period. The list of potentially restricted drugs included streptomycin, selected forms of penicillin, chlortetracycline, and Bacitracin. A writer for *Wallaces’ Farmer* asserted that although the use of antibiotics as therapeutics and as feed additives were concerns to the FDA, it was their therapeutic use that was the most problematic.²²

Two groups responded with objections, the Iowa Pork Producers Association and the National Pork Producers Council based in Des Moines. Rolland “Pig” Paul, president of the National Pork Producers, wrote a letter to the FDA urging a delay on any ban. Paul wanted to know if the issue of antibiotic residue in meat products was significant enough to warrant a ban. He assured FDA officials that hog farmers wanted consumers to have safe meat, but asserted that the degree to which those residues actually constituted a health threat was not clear to producers. Similarly, a representative of the Iowa organization stated that safe meat was “essential for the survival of the [livestock] industry,” but that any regulations had to be “workable.” What was workable for hog farmers included maintaining antibiotics for therapy and for feed, which was precisely the issue for the FDA scientists and concerned citizens.²³

The problem of chemical residues in meats resurfaced in 1970. The USDA, charged with inspection of meat packing plants and meat grading, was now part of the system of

²² Ron Lutz, “Groups cite opposition to FDA drug ban talk,” *Wallaces Farmer*, 22 June 1968.

²³ Lutz, “Groups cite opposition.”

reporting and oversight for chemical residue. An anonymous official at an Iowa meatpacking plant reported that he had a list of ten Iowa farmers who were out of compliance with acceptable levels of residues in animals that they marketed over the previous several weeks. “The next time these people market livestock,” he stated, “the federal meat inspection division in Washington wants tissue samples from their animals to check for drug and pesticide residues.” The federal government was prepared to hold individual farmers accountable for the ways in which they used chemicals.²⁴

Officials at the USDA and the office of the Iowa state veterinarian explained the new compliance program. If liver tissue samples from a packing plant indicated that drug residues were 20 percent under the official tolerance level, the lab would notify the packing plant of origin that they were at risk of violations. If the samples showed residues between 20 percent and the stated level, animals from the farm of origin would be sampled the next time the farmer marketed livestock. Animals that tested above the tolerance level would be withheld from slaughter or destroyed. The director of the USDA program stated that there were several shipments of livestock from Iowa that exceeded the established tolerance levels by over 20 percent.²⁵

The problem for farmers was that some cattlemen did not follow the guidelines for the use of these chemicals, notably stilbestrol. As early as 1958 experts recommended withdrawing stilbestrol from feed forty-eight hours before marketing. This allowed DES to clear the animal’s system before slaughter. But when the new USDA compliance program began in 1970, cattle showed up at packinghouses that exceeded the tolerances for residue.

²⁴ Ron Lutz, “Crackdown on residues in meats,” *Wallaces Farmer*, 8 August 1970.

²⁵ Lutz, “Crackdown on residues.”

The state veterinarian reported that he had contacted “about a dozen” farmers about residues over the previous year. Furthermore, feed additives were just one category of chemicals that showed up in tissue samples. Chlorinated hydrocarbon insecticides were also present, although the most common drug found in cattle tissue samples was stilbestrol.²⁶

Iowa State University experts confirmed what packers, the FDA, and USDA already knew: that a sizable minority of farmers did not understand feeding guidelines. An Iowa State University study from 1966 indicated that of farmers who raised beef cattle, 79 percent recognized that stilbestrol should be withdrawn from cattle rations forty-eight hours before marketing. Twelve percent of farmers disagreed with the forty-eight hour statement, although it is unclear if they believed that the rules were more or less stringent. The fact that the remaining 9 percent of cattle producers had no opinion on the withdrawal rule indicated that there was a serious problem with farmers who did not understand the rule, could not understand, or chose to ignore it.²⁷

In 1971 there were new efforts to control the farmers who misused stilbestrol. In January the American National Cattlemen’s Association and the National Livestock Feeders Association announced a new voluntary program to prevent DES contamination in the meat supply. Beginning on March 1, feeders would sign certificates to assure packers that the cattle being marketed had not been fed DES for at least forty-eight hours prior to slaughter. Feed manufacturers and organizations such as the Animal Health Institute supported the program and offered pamphlets outlining the new program to farmers, farm journalists, and

²⁶ “New stilbestrol research,” *Wallaces Farmer*, 15 March 1958; Lutz, “Crackdown on residues.”

²⁷ “Behavior Studies Related to Pesticides,” Agricultural and Home Economics Experiment Station, Cooperative Extension Service, Iowa State University, *Special Report No. 49*, December 1966.

members of farm organizations such as the Future Farmers of America in the first half of 1971.²⁸

The certification program did not succeed in changing farmers' behavior regarding stilbestrol use. In the summer of 1971 a poll of Iowa farmers indicated that 48 percent of them believed that their neighbors did not follow the recommended withdrawal period for DES. Forty-four percent of farmers reported that they were unsure about whether or not their neighbors were in compliance. The most damning figure, however, was that 8 percent of farmers knew at least one person who did not observe the prescribed withdrawal period. If even a handful of producers failed to follow the guidelines, then those producers could jeopardize the future of DES and other medications.²⁹

Most farmers who wanted to continue using drugs and feed additives recognized the risks of failure to follow the rules. According to Don Lefebure, a hog farmer from Linn County, "It's better and easier to follow withdrawal recommendations than to have the FDA or some other government agency enforcing stringent regulations." Lefebure was not alone. "I don't agree with some of the withdrawal requirements," echoed an unidentified cattleman, "If they [government inspectors] found residues in the meat I sold, I'd be out of business." These farmers urged their peers to use medicated feed properly to ensure that the drugs would be available for all producers. Roy Kleppy, president of the National Pork Producers Council explained that farmers were meat consumers, too. "I don't want anything in it [meat] that's detrimental to my family or other consumers," Kleppy noted. Farmers were caught in the middle. Facing market pressure for low cost meat they used drugs to reduce

²⁸ Ralph Sanders, "Beef Management," *Successful Farming*, January 1971; "Drug withdrawal certificate clarified," *Wallaces Farmer*, 26 June 1971.

²⁹ "Take animals off drugs before slaughter time," *Wallaces Farmer*, 14 August 1971.

production costs, but by using drugs they potentially alienated consumers and their government representatives in Congress and regulatory agencies.³⁰

In 1971 the USDA and FDA changed the stilbestrol withdrawal period from forty-eight hours to seven days. Inspectors found that ten out of approximately 2,500 liver samples from slaughtered cattle indicated the presence of DES. Pressured by the public and Congressmen to ban stilbestrol, government agencies could not afford to be idle. Regulators wanted to prevent a ban by lengthening the withdrawal period. They hoped that recalcitrant producers would see the importance of compliance and change their behavior. The voluntary certification program continued, reflecting the new seven day period for withdrawal. FDA and USDA representatives affirmed that “we simply cannot have any DES residues in the food supply” and that producers shared a large part of the responsibility for reassuring consumers that the meat supply was safe. On January 8, 1972 the certification program became mandatory.³¹

Farmers’ experiences with the certification program, however, were not encouraging. In early 1972, one year after the voluntary certification program began and several months after the commencement of the mandatory program, a majority of farmers surveyed stated that livestock buyers had not asked them to sign any sort of drug compliance statement. While 12 percent of farmers reported no livestock sales in the previous year and therefore had not been asked to sign the statement, only 18 percent of farmers stated that buyers asked them to sign. The good news for farmers was that feeders that raised the largest numbers of animals were more likely to sign a withdrawal form. Buyers asked 55 percent of farmers

³⁰ Wil Groves, “Needed: a common sense approach to feed additive use,” *Wallaces Farmer*, 14 August 1971; Gary Wall, “Feed Additives...Drug Crisis in Agriculture,” *Iowa Agriculturist* (Spring 1972).

³¹ Wil Groves and Bob Dunaway, “Stilbestrol threatened by illegal residues” *Wallaces Farmer*, 27 November 1971.

who fed more than 200 cattle to sign and 30 percent of hog farmers who raised more than 500 head. Yet even the good news was bad. The withdrawal statement program failed to accomplish what it was supposed to do. As long as 45 percent of large scale beef producers and 70 percent of large scale hog producers did not sign drug statements it was likely that animals would arrive at the packing plants with drug residue in their systems.³²

Farmers and their representatives in the United States Congress fought for the right to continue using feed additives. In the summer of 1972 there were several bills pending in Congress to ban DES. In August, the FDA announced that it would ban DES in livestock feed after January 8, 1973. Farmers could still use DES implants which could be placed behind the ear of cattle. Two members of Iowa's Congressional delegation co-sponsored a bill to allow the continued use of stilbestrol. They argued that the only way to get cancer from DES was to ingest massive quantities of it. If the FDA was not bound by the Delaney Amendment, they argued, the FDA would be able to guarantee a safe food supply without banning the drug. This effort was unsuccessful, however. The ban on DES as a feed additive took effect on January 8, 1973.³³

Farmers pledged to continue using DES after the ban, even though they would no longer be able to use it as a feed additive. In July approximately 600 cattle feeders met in Ames and signed a petition urging the federal government to allow "realistic" amounts of DES in cattle tissues at time of slaughter. They argued that trace amounts were safe, and that a total ban would increase farm costs so much that it would be difficult to stay in business. Implanting DES required more care and labor than feeding, since it was a separate task.

³² "Feeders not asked for drug statement," *Wallaces Farmer*, 8 April 1972.

³³ Clark Mollenhoff, "FDA Halts Use of DES in Livestock Feed," *Des Moines Register*, 3 August 1972; George Anthon, "Farm State Congressmen Fight DES Ban," *Des Moines Register*, 4 August 1972.

Common implanting errors included gouging ear cartilage, severing ear veins, and implanting the pellet between layers of skin instead of under the skin, which prevented proper absorption of the hormone. Robert Lewis of Mitchell County estimated that his production costs would increase by as much as 15 percent for his herd of 1,100 cattle. The more serious critique of the stilbestrol ban in feed was that implants were not removed before slaughter. The implant continued to release the hormone up to the time of slaughter, leaving farmers in the same position as they were when some farmers continued to feed stilbestrol laced feeds beyond the specified withdrawal period. The executive vice-president of the Iowa Beef Producers Association stated that the ban was less about a safe food supply and “more of a psychological and emotional action than anything else.”³⁴

Meanwhile, hog producers also faced increased restrictions on feed additives. In January, 1972 the FDA recommended banning several popular antibiotics in hog production and tightening controls on other antibiotics. At a meeting of pork producers, Vaughn Speer, ISU swine nutritionist, explained that the FDA officials feared that the use of antibiotics in livestock feed could potentially cause resistance in microorganisms that were also harmful to humans. The swine editor for *Successful Farming* speculated that bans or limits on antibiotics could be even more serious to hog producers than a ban on DES would be to beef producers. As farmers raised larger herds and used more confinement systems (see chapter

³⁴ Don Muhm, “Cattlemen Urge Allowing ‘Realistic’ DES Amounts,” *Des Moines Register*, July 14, 1972; “Care Needed in Implanting DES,” Iowa State University Information Service, For Immediate Release, Wise Burroughs Papers, Iowa State University; Virgil Oakman and Jerald Heth, “Farmers: ‘We’ll Use DES’,” *Des Moines Tribune*, 3 August 1972.

five) antibiotics were “the crutch that keeps them in business.” Without antibiotics the new, modern hog business would collapse.³⁵

Antibiotics were just one kind of substance that turned up in the meat supply. The fact that other chemical residues were also present in animal tissue contributed to the problem farmers faced in preserving those chemicals as an important part of livestock husbandry. An Iowa hog farmer used an arsenic compound to control an outbreak of swine dysentery in his herd, but one group of hogs received an overdose. The USDA veterinarian took tissue samples from twenty-one of the fifty-two animals, and all the carcasses were frozen during the analysis. The test results showed that the levels of arsenic were within acceptable tolerances, and so the meat entered the food supply, although the heads and viscera were condemned. The practical lesson that farmers learned from this incident and others was that it was costly and time consuming to conduct the tests, freeze the carcasses, and then have part of the byproduct destroyed.³⁶

Farmers were on the defensive as the 1970s began. In the 1950s they were eager to obtain the antibiotic and hormone wonder drugs. Farmers used antibiotics and hormones to speed the rate of gain and to accomplish those gains with less feed. Feeding chemicals was a survival strategy for livestock producers, but now that strategy was troubling. The drugs that boosted production were now the subject of debate among people far removed from production agriculture. Farmers believed that the decisions about what drugs they could or could not use and the withdrawal periods for those drugs were based on fear, not fact. They, in turn, behaved without fear and fed stilbestrol in violation of the guidelines of the product

³⁵ Rodney J. Fee, “Will You Spend Five Minutes on This For To Save Additives?,” *Successful Farming*, August 1972; “Hogmen could lose some feed additives,” *Wallaces Farmer*, 23 September, 1972.

³⁶ “Farmers find drug residues are costly,” *Wallaces Farmer*, 8 April, 1972.

developers at Iowa State and government bureaucrats. As a result, they lost the fight over stilbestrol in cattle feed. The fight over antibiotic feeding did not end in the 1970s. It was unclear how much, if any, antibiotic residue would be acceptable in hog tissues. Faced with concern from prominent members of Congress, advocate-journalists and members of the public, farmers defended themselves and their production choices, just as they defended the other decisions they made about pesticides and fertilizer.

CHAPTER FIVE

Push Button Farming

The farmer dozed in bed as the alarm went off on a cold February day. It was three o'clock in the morning. Instead of rising, pulling on several layers of clothes, boots, and overshoes and heading for the barn to prepare for the morning milking, the farmer stayed in bed. He simply stretched his leg out to a console on the bedroom wall with buttons marked "Chores," "Feeding Cows," "Slopping Hogs," and pushed the button marked "Milking" with his toe. There was no rush to get to work. A sign on the foot of the bed marked "In Conference Until 12:00 Noon" indicated that the farmer would not hurry to work any time soon. This imaginary scene was the creation of a cartoonist for *Wallaces' Farmer and Iowa Homestead* in January, 1951. The title, "Pushbuttons By '60?" suggested that this was a humorous take on a serious issue, the role of mechanization on Iowa farms in the postwar period. Specifically, which of the time consuming jobs such as milking, hauling milk in cans, shoveling manure, and scooping feed for livestock would be mechanized in the years to come? To what extent would farmers be able to reduce the amount of physical labor required to operate a farm? How would farmers use push button techniques to change the way they farmed?¹

The idea of automated or push button technology was a graphic one for farmers who did the milking, feeding, and manure removal chores 365 days of the year. Labor saving devices had always appealed to some farmers, but the drive for labor savings in the work farmers performed every day accelerated in the postwar years. Push-button imagery suggested a modern world of comparative ease, one in which farmers could leave behind the

¹ Tony Basso, "Pushbuttons By '60?," *Wallaces Farmer*, 21 January 1950.

stoop labor of agriculture. By the 1960s, the rhetoric of push button farming gave way to the language of automated materials handling systems, but the appeal to farmers was the same. Automated materials handling replaced the scoop shovel for many jobs on Iowa farms in the postwar years, although the degree to which that change occurred varied from farm to farm, depending on the degree of specialization and size of operation.

Pushbutton techniques represented the ultimate fulfillment of the industrial ideal in farming. Unlike many of the harvest tasks that farmers mechanized (described in following chapters), dairying, feeding livestock, and moving manure were everyday chores that took several hours per day on most farms. Automated materials handling systems could be used to specialize or expand production. Farmers with small acreages or herds as well as those with larger operations benefited from the economies made possible by pushbutton techniques. Dairy farmers were among the first to use pushbutton techniques, installing new milk handling systems in the 1950s. They did so in response to the widespread availability of electricity, rising labor costs, and changing requirements for producers of Grade A milk. Families who fed beef cattle quickly turned to automated choring systems, although the scale of automated operations varied, depending on the size of the operation. Finally, farmers used automated materials handling to move beyond the feedlot. They concentrated large numbers of animals together in confined spaces, sometimes indoors. Automated systems fed animals, watered them, and even removed manure. Confinement feeding of large numbers of hogs and cattle became a possibility during the 1960s, although farmers who practiced confinement feeding had to deal with a growing waste management problem as the 1960s ended.

The combination of the farm labor shortage and the spread of rural electrification made pushbutton techniques an option for farmers in the 1950s. In Iowa, rural electrification was just underway by the time World War II began. In 1940 approximately 34 percent of the 209,737 occupied farm homes in the state claimed electric power. In the 1940s, however, the electrification of farmsteads proceeded quickly, and by 1951 almost all Iowa farms had electricity. Farmers of the 1930s only envisioned installing a few electric lights in their homes, barns, and outbuildings and powering a few appliances at a cost of approximately twenty-five kilowatt hours per month. By 1950 that situation had changed for a growing minority of farmers, who now used 1,000 kilowatt hours or more of electricity for many farm tasks. Farmers could realistically conceive of using the new technology to do much of the repetitive and strenuous stoop work on their farms at a time when there were fewer strong backs to do the work and those who remained could demand higher wages. With the decline in farm labor and the rise in rural electrification, an electric powered materials handling system could become the new “hired man” on many farms.²

One of the first areas of farm life in which farmers began to apply push button techniques was dairying. Dairying was (and remains) one of the most labor intensive of all tasks and work cycles on the farm. Cows need to be milked twice per day, barns need to be cleaned every day, and milk must be stored until it can be hauled to a processor. All of the tools and implements that touch milk require cleaning and sanitizing before they can be used again. In the late 1940s several developments that would reduce some of this labor of dairying attracted attention: the pipeline milker, the bulk tank, and the milking parlor. With a

² *Forty-first Annual Iowa Year Book of Agriculture*, 1940, 319; *Fifty-second Annual Iowa Year Book of Agriculture*, 1951, 349; “Lighter Chores in '60,” *Wallaces Farmer*, 4 February 1950.

pipeline milker, the milk moved directly from the cow into a glass container, then through tubes into a bulk cooling tank. In 1950 hand milking was the norm for over half of all cows in Iowa by while only 45 percent of cows experienced machine milking. Both techniques, however, exposed the milk to contaminants, including dirt, manure, insects, and airborne pathogens. The person who did the milking also had to carry and pour the milk into cans and then move the cans to the milk house for cooling in a water bath. In 1951 Gerald Prince of Guthrie County carried milk cans over eighty-eight miles per year and covered a total of 375 miles in his dairy operation. Pipeline milking systems eliminated the need for this physical work. The milk moved by machine, freeing the farmer to pay attention to washing udders and operating the machines. Milking parlors had raised stalls for the cows, so the farmer could clean and inspect udders and attach the milking machinery without bending over. Taken together, these developments could relieve farmers of stoop labor and allow them to milk more cows faster, but they also promised to increase costs.³

The most significant appeal of new technology was the ability to increase the pace of work which cut costs. With labor expenses accounting for approximately 25 percent of the cost of dairy farming, any reductions helped increase profits. New style milking parlors were one of the most effective means of cutting labor costs. The Yoder family from rural Kalona reduced costs of getting milk to Iowa City from \$.35 per hundredweight to \$.22 using a milking parlor and bulk system. The layout of milking parlors varied, but one of the popular styles after 1957 was the herringbone type. It is easy to imagine this type of set-up if you

³ For more information on Iowa dairying, see George W. Ladd, "Trends in the Iowa Dairy Industry," Agriculture and Home Economics Experiment Station, Iowa State University, Ames, Iowa, *Special Report No. 54*, November 1967. Schlebecker, *Whereby We Thrive*, 254, 302-303; Rueben W. Hecht, "Labor Used For Livestock," U.S. Department of Agriculture, Agricultural Research Service, *Statistical Bulletin No. 161* (Washington, D.C.: U.S. Government Printing Office, May 1955), 9; Bill Giese and Don Muhm, "Dairying without carrying," *Successful Farming*, February 1951.

envision parking on a one-way street of a small town. Just as cars face the sidewalk at an angle with their tail lights to the street, cows in a herringbone milking parlor face their feeder with their tail ends angled toward the operator's pit. A gate closed behind the last cow and the close quarters kept the cows from moving. A pull on a rope or chain released a fixed amount of feed into the feed cups from overhead storage bins. The operator could see the udders and attached the pipeline milkers to the cows as they closed in. Pipeline milkers carried the milk to a bulk tank. Instead of hauling the milk from each cow to a can by hand which, in turn, would have to be carried to a milk house where the cans would be placed in cool, moving water, the bulk tank eliminated the need for physically moving the milk. This system allowed farmers to milk much faster than the old way of taking an individual milking unit to each cow in a stanchion. As soon as one group of cows finished, another group would be queued outside the door ready to be milked.⁴

Dairy farmers commented on the welcome increased pace of milking in the new-style parlors. Kenneth Showalter of Franklin County found that he could milk his twenty-three cows by himself in one hour with his new milking parlor. Formerly, Showalter and his hired man each spent an hour milking with a stanchion system and portable milking machines. "This new set-up saves from two to two and a half man-hours per day," Showalter concluded. In the mid-1950s Rudolph Remmen of Winneshiek County decided to upgrade his facilities. His stanchion barn only had room for twenty-three cows, so he constructed a new milking parlor to accommodate twelve cows at a time. He expanded his herd to fifty-two cows. With an average milking time of fifteen minutes for each group of twelve cows, Remmen was able to complete the entire herd in approximately one hour. Farmers with

⁴ "How They Make Dairying Pay," *Iowa Farm and Home Register*, 6 March 1955.

larger operations realized larger labor savings. The Hermanson brothers of Story County kept a herd of 150 Holstein cows and were one of the first operations in Iowa to use the herringbone style. They could milk between fifty to sixty cows per hour in their double-six herringbone. According to Leonard Hermanson, “It took three men all day just to milk and feed the cows [in stanchions]. Now, two men can handle the same work in about six hours.”⁵

Creature comforts were important benefits to the new style milking parlors.

Milking parlors were easier on the operator than the old stanchion milking barns in which farmers had to constantly bend over to clean udders, check them for problems, and attach or remove milking machines. New milking parlors were also self-contained, either as separate buildings or enclosed spaces within barns, making it easier to control the environment by keeping down dust, keeping flies out, and even providing heat in the winter. On one Wright County farm, three boys claimed to enjoy milking in their new milking parlor. They installed a radio and a propane heater to make the work more pleasant. Vernon Miller of Black Hawk County found that the raised stalls made it easier for his father, who suffered from rheumatism in his knees, to assist with milking. Eldon Johnson, also of Black Hawk County, commented that working in the pit was comfortable, “And it eliminates the danger of being kicked. Also, the udder is in clear view and easy to wash.” While farmers did not cite comfort as the most important benefit of milking parlors, they enjoyed the new ease of work.⁶

⁵ “Cut Cost of Milk Production,” *Wallaces Farmer*, 21 February 1953; James R. Borcharding, “New parlor let him double herd size,” *Successful Farming*, March 1959; “Milk more cows with less work,” *Wallaces Farmer*, 6 June 1959.

⁶ “Boys like to milk cows,” *Wallaces Farmer*, 17 March 1956; “Want Push-Button” Dairy Barn?,” *Wallaces Farmer*, 21 October 1950; “Iowa dairyman tries new milking parlor,” *Wallaces Farmer*, 15 March 1958.

Bulk tanks were a critical part of new-style dairying. Bulk tank technology was initially developed in California, where some of the first large-scale dairy operations began. Farmers could either pour the milk from the milking units into the refrigerated tank by hand or they could use pipeline milking machines to automatically transfer the milk from cow to tank. These electric powered cooling tanks held several hundred gallons of fluid milk. Once the milk was in the tank, the farmer only needed to wait for a dairy tank truck to pick up the milk on an every-other-day basis. In addition to labor savings and reduced physical labor, there were other advantages of bulk handling. There was less opportunity for spillage and less opportunity for bacteria growth because of rapid cooling. Promoters of bulk handling also suggested that dairy work was more attractive to hired labor since there was less physical work. Bulk handling would also allow farmers to produce fluid milk that would be classified as Grade A: milk for drinking.⁷

New standards for farmers who sold fluid milk posed a major challenge to farmers who wanted to produce for the market with the highest prices. The state legislature passed a law in 1951 with more stringent sanitation requirements for processors who marketed milk labeled Grade A. Milk at Grade A processing plants could not test in excess of a bacteria count of 400,000 per million and finished milk could not exceed 30,000 per million. The E.coli count of finished products could not exceed ten parts per million. Dairy processors wanted to ensure high standards, so they asked more of farmers. If farmers could not provide raw milk from disease-free herds that met these standards they would be limited to producing for a Grade B market, which was less profitable. Over the course of the 1950s, the issue of

⁷ Dick Hanson, "Less work, more profits with milk tanks," *Successful Farming*, August 1952; W. H. M. Morris and Henry A. Homme, "What is Bulk Milk Handling?," *Iowa Farm Science*, 8 (June 1954).

making the grade in milk production was an important reason for farmers to consider new-dairy technology.⁸

Farmers found that the potential for expansion was an important consideration when studying merits of bulk handling. This potential for expansion was critical considering the cost of these tanks. A farmer who owned a cooler for milk cans claimed that his bulk tank was a good investment since his can cooler was too small for his production. Farmers who owned bulk tanks wanted to keep them full, which would allow them to pay for the system as soon as possible. Alex Young of North Liberty produced for the Iowa City market. He claimed that with his pipeline milker and 400 gallon bulk tank he could increase his herd from fifty cows to seventy cows without increasing his work load. Young stated that "...the only thing left for me to do is to put the milker on the cows. Of course, I have to keep the equipment clean. But the tank is easier to wash than milk cans, and the pipe doesn't take a great deal of cleaning time." In 1958 a farmer from Benton County noted that his two-year old 250 gallon tank was not big enough to handle milk from his expanding herd. He planned to trade in for a larger model in the future. In the interim he needed to have the local dairy processor come every day to pick up milk instead of every other day.⁹

Pipeline milking and bulk tanks reduced labor and allowed farmers to expand, but automatic feed grinding and moving feed to the cows also reduced labor requirements. Scooping each pound of feed to cows was a bottleneck that limited the profit potential of the new parlors, pipeline milkers, and bulk tanks. Dairy farmers frequently mixed supplements

⁸ *Fifty-second Annual Iowa Year Book of Agriculture*, 1951, 41; Henry A. Homme, Eddie Easley, and John Shaul, "If you're thinking of going Grade A," *Iowa Farm Science* 7 (November 1952).

⁹ "Dairymen find bulk tanks pay," *Wallaces Farmer*, 21 February, 1959; Hanson, "Less work, more profits with milk tanks," "Bulk tanks reduce costs," *Wallaces Farmer*, 19 October 1957; "Which bulk tank for you?," *Wallaces Farmer*, 1 March 1958.

with grain or silage to provide a more balanced ration for lactating cows, which was time consuming work. Norman Amundson of Clayton County ground, mixed, and even bagged his own feed before feeding it to his cows by hand. In the 1950s, however, he began to have feed ground and mixed in town and delivered to his farm. He installed a 100 bushel steel feed bin and an electric powered auger system to deliver the feed to a device that metered out feed to each cow in the parlor.¹⁰

The majority of feeding for milk cows, however, took place outside the milking parlor. During summer, farmers traditionally grazed milk cows on pasture. During the colder months, farmers fed forage and silage that comprised the bulk of the dairy ration in outdoor lots or enclosures. In the 1950s, due in large part to changes in forage harvesting (see chapter six), farmers began to feed cows in lots throughout the year. This was called dry lot dairying. Forage choppers cut and chopped the crop into short lengths which were blown into a forage wagon with an automatic unloader. By feeding cows in the lot instead of grazing, farmers were able to maximize production from their forage acres. Simply put, each acre could support more cows in a lot than by grazing on pasture. A Wisconsin study indicated that ten acres would support seven cows with rotational grazing while those ten acres could support fourteen cows by harvesting the grass by machine. Jack Hansen of Black Hawk County installed an auger system to deliver silage from the silo to the feed bunks on his farm, which lessened the work needed to feed his herd of sixty cows. This type of dairying meant more hauling of feed, but more production per acre of grassland.¹¹

¹⁰ "How to handle a bigger dairy herd," *Wallaces Farmer*, 2 August 1958.

¹¹ Dick Hagen, "Drylot dairying," *Wallaces Farmer*, 20 May 1961; Ken Hofmeyer, "Dairying is changing," *Wallaces Farmer*, 5 June 1965.

All of these tools cost money. Costs varied depending on the size of the parlor and milk handling system, but farmers in the 1950s could expect to pay at least \$6,000 for a parlor that could accommodate eight cows at a time. Not surprisingly, costs were lower for milking systems suited for larger herds. According to a Michigan State University study, a herringbone system designed to milk as many as forty-five cows per hour could cost as little as \$6,040 while a system for twenty to thirty cows per hour was estimated to cost from a low of \$6,365. Similarly, a University of Minnesota study indicated that bulk tanks were more economical for larger producers than smaller producers. Bulk tanks for Iowa producers cost from \$2,000 to \$3,000, depending on tank capacity. Farmers who produced 250 pounds of milk per day would expect to pay \$.28 per hundredweight for a 200 gallon tank versus a farmer who produced 650 pounds of milk per day who paid \$.11 for the same sized tank. These costs included depreciation, and estimated taxes, repairs, insurance, and interest charges. In the 1950s, this was the most expensive capital investment farmers could make outside of land and livestock purchases. Accordingly, farmers had to assess their commitment to dairying before they invested in new technology.¹²

One Delaware County operation shows the degree of capitalization required to set up a modern dairy farm. Howard Stone, his son Jim, and neighbor Don Miller formed a partnership to update a farmstead. Their existing facility included a stanchion barn and loafing shed (a shelter for cattle to get out of the weather) as well as two silos and a milk house for storing milk as it cooled. They invested \$8,000 in a new milking parlor, milk handling system, a new loafing shed that doubled the size of the previous structure, a straw

¹² "Bulk tanks reduce costs," *Wallaces Farmer*, 19 October 1957; "Dairymen find bulk tanks pay," *Wallaces Farmer*, 21 February 1959; "Milk more cows with less work," *Wallaces Farmer*, 6 June 1959.

storage shed, and feed bunk. They fed silage and chopped hay in the feed bunk from a self-unloading wagon and fed cows in the milking parlor from overhead bins.¹³

The high first-cost of new milking parlors, pipeline systems, and bulk tanks posed a dilemma for any farm families who sold fluid milk in addition to producing cream for sale and use at home. Should they expand their herds to realize the economies of scale? Most dairy producers answered negatively. They chose to engage in other farm tasks that were less risky and expensive than producing milk. The number of farms dedicated to dairying dropped quickly in the 1950s and 1960s while the average number of animals per dairy herd increased. Farmers who maintained a small herd of approximately half a dozen cows to produce for home dairy needs and to sell some cream had no use for the new dairy equipment. Those who did not invest in the pipeline milkers, bulk tanks, and milking parlors invariably left dairying or farming altogether. In survey of Iowa farmers indicated that the new dairy techniques were the tools of the minority rather than the majority. Only 12.5 percent of respondents owned bulk tanks, 11 percent owned pipeline milkers, and only 6 percent had milking parlors.¹⁴

Dairy farmers expressed their tension over expansion. Alvin Brown of Black Hawk County declared, "A man is going to have to dairy in a big way---or not at all." Brown sold his herd of twenty cows in the winter of 1954-55 rather than invest in the new equipment. Another farmer who increased his herd noted that "It's to the point now where you either get

¹³ Newt Hawkinson, "Dairy setup designed for efficiency," *Wallaces Farmer*, 8 February 1962.

¹⁴ "Dairy survey information," *Wallaces Farmer*, 1 August 1959; Jim Rutter, "Automatic choring equipment," *Wallaces Farmer*, 18 July 1959. There is some contradictory evidence on the numbers of farmers with pipeline milking systems. One article highlighting a survey of dairy farmers indicated that as many as eleven percent of farmers used pipeline milking systems, while an article from July 18 indicated that only five percent of Iowa farmers used pipeline systems. It is impossible to gauge the accuracy of either survey, but it does suggest that there were many people who continued to produce fluid milk in traditional structures.

in or get out.” When Hardin County farmer Roy Engel’s milk buyer began to take bulk milk Engel sold his herd of fourteen cows, explaining that “I never enjoyed dairying too much anyway, and I didn’t want to get in so deep that I couldn’t get out if I wanted to [sic].” Engel sold milk as part of a diversified operation as a hedge against crop failure or price declines for crops or livestock. But in the new world of dairying, he found that continuing to produce milk was not worth the expenses of expansion. In 1961, Harry Clampitt, Hardin County farmer and president of the American Dairy Association of Iowa, expressed his view of contemporary changes in dairying. Clampitt questioned “whether going into dairying on a 10-15 cow size is going to be popular or profitable.” As the 1960s began, an increasing number of farmers ceased dairying and the remaining number increased the scale of operations. Attrition out of milk production meant that the technological solutions of the minority became commonplace on dairy farms.¹⁵

Farmers who chose to remain in dairy production added more cows to their herds. As indicated previously, the cost of the new equipment compelled farmers to maximize production to pay for it. Melvin Hoelscher of Hardin County was one of these farmers who expanded after investing over \$3,000 in his new bulk tank and pipeline system. “I’ve got to get it [the investment] back somehow. And the only way to do it is to milk more cows.” A Northeast Iowa dairyman expanded his herd dramatically. In the early 1950s he milked a herd of from fifteen to eighteen cows per year. By 1955 he expanded to thirty-seven cows and wanted to milk from forty to fifty head. “I was ready to quit,” he noted, “But the wife and boy said they’d do the milking if I’d build ‘em a new milking parlor.” John and Fay

¹⁵ Dave Bryant, “Dairy herds getting bigger—fewer,” *Wallaces Farmer*, 15 October 1955; Richard Hagen, “Dairying faces changing times,” *Wallaces Farmer*, 17 June 1961.

Hostert of Dubuque County began to increase their herd from fifty to seventy cows in 1957. They reasoned that it was worth expanding because they had already invested in the new equipment. “And,” they explained, “it’s no more work to milk 70 cows than it was 50.” These farmers found that technology solved their short term problems of high labor costs and gaining access to the higher priced Grade A market for milk. Expansion with new technology was the only farmers believed they could increase profits and remain in dairying.¹⁶

The numbers of dairy cows and production figures per cow reveal the scope of the change wrought by farmers who used new technology. There were 1,007,444 cows and heifers for dairy production on Iowa farms in January, 1951, the year that the requirements for Grade A milk production became more stringent. By the beginning of 1962 there were only 769,810 dairy cattle in the state, although they produced more milk than ever before. There were fewer cows, the farmers who remained in the dairy business increased the size of their herds. The number of farmers with herds of twenty or more cows increased from 1950 to 1955 by one third. With new equipment farmers were able to increase their production and expand their herds.¹⁷

The experiences of dairy farmers in the Sioux City milk shed demonstrate the consolidation in dairying. The number of farms in Iowa, Nebraska, and South Dakota that produced fluid milk for the Sioux City market declined precipitously from 1950 to 1960. In 1950 there were 730 dairy producers, in 1955 there were 480, and in 1960 there were just 170 producers producing for consumers in Sioux City. However, the production for that

¹⁶ Dave Bryant, Dairy herds getting bigger—fewer”; Ken Hofmeyer, “How many cows should you milk?,” *Wallaces Farmer*, 5 October 1963.

¹⁷ *Fifty-first Annual Iowa Year Book of Agriculture, 1950*, 570; *Fifth Biennial Report of Iowa Year Book of Agriculture, 1960-1961*, 351; Hagen, “Dairying faces changing times.”

market increased, more than offsetting the loss of dairy farmers. In 1955 Sioux City processors handled 34 million pounds of milk from 480 producers. In 1960 they handled 76 million pounds of milk from only 170 producers. This concentration of dairy production and increased productivity was testimony to the efficacy of new techniques adopted by Iowa dairy farmers and their families.¹⁸

Farm families who chose dairying as their principal source of income instead of a sideline kept up with other new developments, in particular loose housing and free stall housing. In the 1950s, these two new kinds of housing for dairy cows became common in Iowa and the United States. The old-style stanchion barns had individual places for each cow to come for feeding and milking. Stanchions held cows in their place during milking. When the cow put its head into the stanchion for feeding the farmer moved a vertical bar into place that prevented the cow from backing out. In cold weather cows often remained in the stanchions. By contrast, a loose housing barn was simply a structure without the rigid organization of individual stanchions for each cow. Instead of milking in the barn, farmers milked the cows in the specialized parlors described previously. In the loose housing barn, cows moved around the barn at will. The floor was a packed earth covered with straw and animal manure which generated heat in the winter to keep cows warm. They were fed in a common feed bunk in addition to the special mixed feed they received in the milking parlor.¹⁹

¹⁸ Dick Hagen, "Goodbye to milk cans," *Wallaces Farmer*, 21 January 1961. John T. Schlebecker noted that production and efficiency in American dairying increased 98 percent per man hour between 1940 and 1958. *A History of American Dairying* (Chicago: Rand McNally and Company, 1967), 40.

¹⁹ Thayer Cleaver and Robert G. Yeck, "Loose Housing for Dairy Cattle," U. S. Department of Agriculture, *Information Bulletin No. 98* (Washington, D. C.: U. S. Government Printing Office, 1953), 2. For an updated version of this bulletin, see "Loose-Housing System For Dairy Cattle," U. S. Department of Agriculture,

Loose housing systems were as distinct as the individual farmers, reflecting tenure status and available capital. Land owners typically had more extensive livestock operations, since the buildings, lots, and equipment would remain on their own property. J. Clifford Grant, a farm owner from eastern Iowa, invested thousands of dollars in his system, although he built a barn that he did not intend to build. In 1950 Grant planned to expand his herd and wanted to construct a stanchion barn for seventy-two cows. The contractor who bid on the project encouraged Grant to consider loose housing. After viewing existing loose housing operations and consulting with experts he accepted their advice and built several new structures with trussed frames to make cleaning easier than dodging support poles. He added a steel silo and holding shed, too. Grant's new operation was expensive, but it was possible to start with a loose housing system for much less. Donald Glew, a Delaware County tenant farmer, converted a stanchion barn into a loose housing barn for only \$387. He removed the stanchions on one half of the barn for loose housing for twenty-four cows and used the other half for his milking room and storage area.²⁰

Loose housing systems were much less labor intensive than stanchion milking. Farmers who used pail-style milking machines for a thirty cow herd in a stanchion barn hauled eighteen tons of material per cow, per year, including four tons of milk, two tons of hay, three tons of silage, one ton of straw, one and a half tons of grain and six and a half tons of manure. This hauling and shoveling amounted to one and a half tons per day. Given the amount of work involved with stanchion milking it is not surprising that some farmers wanted to change. Kenneth Winkel of Lyon County explained that he studied many different

Miscellaneous Publication No. 859 (Washington, D. C.: U. S. Government Printing Office, 1961); S. S. De Forest, "Loose Housing means less labor," *Iowa Farm Science* 6 (July 1951).

²⁰ J. Clifford Grant, "Why I built the barn I didn't want," *Successful Farming*, May 1955; Sherwood Searle, "I switched to loose housing for \$387," *Successful Farming*, April 1955.

plans for dairy structures before he tore down his old stanchion barn and replaced it with a modern facility. After only one year of use he claimed “I would stop milking cows before I would go back to a stanchion system.” Aside from labor saving, Winkel cited numerous advantages to loose housing, including greater comfort for cows, cleaner cows, and fewer bruised teats and infections such as mastitis.²¹

Herd health was an important advantage farmers cited of loose housing over stanchion barn systems. Vernon Lyford tore out his stanchion barn and replaced it with a loose housing set up on his Worth County farm in 1950. During his days milking in the stanchion barn, Lyford’s cows endured a bout of mastitis, an infection of the cow’s udder that prevents milk production in one or more quarters of the udder. Since he had the new barn, with cows resting on their own without being confined in the stanchions, there were fewer health problems. “Right now,” he stated in 1953, “I’m milking 34 cows---every one of them giving milk out of four quarters [of the udder].” Farmers invariably had to deal with some illness or health concern that cut production, so providing an environment that was more conducive to good health was the best way to increase production and profit.²²

Labor savings were a significant feature of loose housing. Instead of cleaning out the gutters behind the cows in stanchions every day, farmers cleaned the loose housing barn on an occasional basis. In the new system, milking took place in the parlor, which was kept very clean in ideal operations. With the cows resting on bedding, they were protected from the manure and mud that they would lay in when they were in pasture or in the barn. In the loose housing barn they were on a mat of bedding, which would keep them out of the animal

²¹ “Saving Labor In Dairy Operations,” n.d., Dale O. Hull Papers, Special Collections, Parks Library, Iowa State University; “Cut Dairy Chores,” *Wallaces Farmer*, 1 November 1952.

²² “Loose Housing For Dairy Cattle?,” *Wallaces Farmer*, 1 March 1953.

waste. The alleys would be cleaned out periodically. Dick Moen of Howard County scraped the entire surface of the barn once per year.²³

Similarly, free stall housing was a solution for farmers concerned about cleanliness. The free stall system was like the loose housing except with stalls provided for cattle to use for rest. With individual stalls instead of open space, farmers could save on the amount of bedding. Gerald Ehlinger, a Dubuque County dairyman, constructed a free stall barn with four by eight foot stalls on either side of a twelve foot wide alley. The stalls were earth packed covered with straw and were slightly higher than the alley floor. Ehlinger claimed that his cows stayed clean all winter long with much less bedding than a loose housing system. Farmers experimented with bedding material, using straw, chopped corn stalks and even sawdust in the stalls. By the late 1960s, sawdust became the material of choice. "According to Harold Leazer of Cedar County, "Sawdust alone keeps the cows cleaner and dryer than anything I've tried." Ray Crock Jr., also of Cedar County, raved about the cleanliness of the cows housed in stalls with sawdust. "They're just as clean as during the summer and maybe even a little cleaner." Regardless of the particular bedding material, farmers believed that loose housing would provide a cleaner environment for their cows.²⁴

Families who chose to specialize in dairying were not the only people who employed automated materials handling and changes in architecture to reduce labor costs, expand operations, and ease the hard work of farming. The largest growth in automated materials handling systems was by farmers who raised beef cattle in feedlots, since many more Iowa

²³ "Loose housing shows promise," *Wallaces Farmer*, 1 March 1958.

²⁴ "Free Stalls For Dairy," *Agricultural Engineers' Digest*, Midwest Plan Service, (February 1963). Records of the Midwest Plan Service, Special Collections, Parks Library, Iowa State University; "Comfort' stalls for dairy cows," *Wallaces Farmer*, 7 September 1963; "Dairymen like free-stall housing," *Wallaces Farmer*, 10 February 1968.

farm families depended on the sale of beef cattle for their livelihood than on the sale of fluid milk. Just as most Iowa farm families kept a herd of dairy cows for the sale of cream instead of fluid milk, they also kept a herd of beef animals. This kind of production enabled them to minimize the risks of farming by selling a variety of products. If hogs were selling low, then cattle might be selling high. But just as many families were liquidating their dairy herds, many families were increasing their commitment to feeding beef cattle. In the atmosphere of postwar prosperity, urban consumers wanted more beef. In contrast to dairying, expanding beef herd numbers was comparatively inexpensive, since feeder steers were less expensive than breeding stock such as heifers and cows.

How to raise a larger herd of beef cattle was another matter. Feeding animals required physical labor. While cattle could be grazed on pasture or in harvested corn fields to feed on cornstalks and any remaining ears of corn, farmers needed to “finish” cattle before they could be sold. Finishing was a period in which the animals would be fed grain, silage, plus any number of supplements to rapidly increase their weight to command a top price. Farmers needed to get feed in long troughs called feed bunks at least two times every day. For even a small herd, this amounted to tons of feed every season that had to be moved by hand.

Farmers used a variety of labor saving devices over the years to help feed livestock. Numerous companies manufactured track systems that could be mounted to the ceilings of barns. Suspended cars could be pushed along the track, allowing farmers to move feed or even manure from place to place without carrying it. Still, the feed and manure had to be shoveled into the carrier before it could be moved. Some farmers developed their own systems, making carts that could be moved by hand along the length of a feed bunk, with the

farmer shoveling feed out of the cart at intervals along the bunk. Leo Boddicker of Benton County installed a carrier system in 1948-1949 so that one man could feed 200 steers on a 335 acre farm. Almost all of these innovations relied on hand power and there were physical limits to how much one person could move and, in turn, limits to the numbers of animals that could be fed.²⁵

Automated systems were a reasonable answer for farmers who wanted to ease the work of feeding a large herd of beef cattle or to expand the scale of their operations. In 1954 the magazine *Successful Farming* highlighted the role of automated materials handling in a “Complete report on easier feeding.” The information for this special feature was from a USDA and Illinois Agricultural Experiment Station study on the economies of labor saving on thirty-six Illinois farms. As the authors of the feature noted, most farmers of the early 1950s continued to feed forage and grain the same way that it had been done for a generation or more. This made sense for the farm family that fattened less than 20 head of cattle, feeding by hand was still the most economically efficient method for small herds. By the end of the 1950s, the USDA recommended hand feeding was still the most profitable system for those who fed herds of less than fifty animals.²⁶

But for farmers who hoped to beat the cost-price squeeze by producing more to offset shrinking profit margins, hand feeding was too labor intensive. The most common solution for farmers who wanted to stretch their labor over larger herds was to use new self-unloading wagons to feed silage or grinder mixers to feed grain and other feedstuff. Farmers pulled these wagons with a tractor alongside feed bunks and the self-unloading wagons deposited

²⁵ Dick Hanson, “Work-planned cattle feeding system,” *Successful Farming*, October, 1950.

²⁶ R. N. Van Arsdall and Vernon Schneider, “Faster, easier feed handling,” *Successful Farming*, February 1954; Newt Hawkinson, “When does it pay to mechanize?,” *Wallaces Farmer*, 15 October 1960.

feed in the bunks. In this way, it was possible to move tons of feed without leaving the tractor. The problem was that during the spring thaw it was often impossible to drive through cattle lots.²⁷

The remedy was fence line feeding systems. With fence line feeding, the bunks themselves became part of the fence. Instead of driving into a feed lot and contending with gates, getting stuck, and animals crowding around the bunks or escaping when gates were open, fence line feeding allowed farmers to avoid those inconveniences. They simply drove along the fence to unload into bunks and the work was done. Fence line feeding quickly became a popular method of automated feeding. With self-unloading wagons one person could haul feed for hundreds of animals.

In order to gain this kind of economy, farmers needed to conduct careful planning for structures, lots, and bunks. Because the bunks were part of the permanent fence, they could not be moved to avoid muddy areas like portable bunks. Extension engineers helped farmers plan these systems. As one Pottawattamie County cattleman pointed out, “We’re afraid of mud where the cattle stand and also where you have to drive for unloading.” Of course, these problems could be overcome with concrete next to the bunks for the cattle to stand on and gravel pathways for the tractor, but these measures increased the cost of fence line systems.²⁸

Self-feeders were a less expensive alternative than fence-line feeding, since a farmer could fill the feeders with a large quantity of grain and let animals eat for several days before refilling. These devices could be designed for hogs or cattle, with wooden units for cattle

²⁷ Cliff Johnson interview.

²⁸ Cliff Johnson interview; “Make cattle feeding easier and quicker,” *Wallaces Farmer*, 15 February 1958.

and galvanized metal for hogs, which tended to be harder on the feeders. A typical self-feeder had a central storage unit and feeding areas at the bottom. This allowed gravity to pull feed downward as the animals ate. Farmers could use grinder-mixers to prepare their own rations consisting of grain, supplements, and forage crops and deliver the feed directly to bunks or self-feeders. Ten years of experience confirmed the value of self-feeders for Hans Hansen of Emmet County. He liked the fact that during busy periods he was not tied down to a time-consuming regimen of livestock chores.²⁹

Farm families who did not own their own grinding and mixing equipment could even have bulk feed delivered directly to their self-feeders. This allowed farmers who did not have large herds to avoid the expense of investing in equipment and also allowed them to spend their time on other farm jobs, especially during corn planting, hay and forage making, and corn and soybean harvesting. As Merrill Randau of Story County explained, “Home grinding ties up both a tractor and a man. I couldn’t afford to do my own grinding, especially when field work is pressing.” Claude Ruckman of Hardin County praised the labor saving qualities of self-feeders. “I take my corn to the elevator and they deliver the mixed ration directly to the feeder. All I have to do is feed hay and check the cattle.” Commercially manufactured bulk feeds gained in popularity during the 1950s and 1960s as farmers relied more heavily on chemical feed additives (see chapter four).³⁰

One of the most efficient push button systems on large beef cattle operations was also found on dairy farms: augers. Electric powered augers could move feed through a tube, discharging the feed from holes in the sides of the tube. On the Wiemers farm near

²⁹ “Self feeders cut choring time,” *Wallaces Farmer*, 7 July 1962.

³⁰ Dick Hagen, “Grain banks save you labor,” *Wallaces Farmer*, 3 January 1959; “Self feeders cut choring time,” *Wallaces Farmer*, 7 July 1962.

Melbourne, an auger system was invaluable in feeding 135 head of Herefords in 15 minutes. The auger system ran from the corn crib and granary, where a home made mixer made from an end gate seeder combined corn and protein before conveying the feed to the silo. At the silo, another mixer added silage to the corn-protein mixture. Then the overhead auger carried the feed to two concrete feed bunks where it fell through chutes into the bunk. As each chute was filled, the auger carried the feed mixture farther down the line until all were filled. According to Orval Wiemers, farming eighty acres and feeding livestock with electric powered systems was preferable to the kind of farming he did during World War II. "I was working myself to death" while farming between 600 to 800 acres at full production. With the new system, Orval could handle the morning feeding and then take care of his implement business. His fourteen year-old son did the afternoon feeding after school. The Wiemers family used family labor to maintain a medium sized herd without hiring workers.³¹

Silo unloaders were another tool that farmers used to cut their labor demands. Instead of pitching tons of silage down a chute from the top of the silo, it was possible to install an electric powered auger that moved around the top of the silo like the hand of a clock, shaving silage off the top and conveying it to a blower that discharged the silage down the chute. To feed silage to 100 steers by hand a farmer could expect to spend approximately one and a half hours per day pitching silage. With an auger unloader that job only took thirty minutes. If a family invested \$1,200 in an unloader to feed a herd of thirty-five cattle, the cost of the machine averaged \$1 per day, which was much less than the cost of human labor.³²

³¹ "15 Minutes to Feed 135 Cattle," *Iowa Farm and Home Register*, 2 May 1954.

³² "Silo unloaders," *Wallaces Farmer*, 21 November 1959.

The potential labor saving of silo unloaders and auger conveyor systems was a powerful incentive for farmers who raised large herds or aspired to raise large herds. Francis Kenkel of Shelby County wanted to expand his beef feeding operation but was concerned about high labor costs. Instead of hiring labor, he installed an automated system that let him feed from 400 to 500 head of cattle per year on his farm. He testified that he could feed 275 animals by himself in twenty minutes. Ovey Vaala of rural Melvin in Northwest Iowa began converting to an automated system in 1947 in response to his frustration with hand feeding from a wagon. He spent up to three hours per day to feed a herd of approximately eighty head. Furthermore, he incurred the expense of using a tractor for that entire time. Vaala installed an auger and tube system over a concrete bunk which would allow him to feed as many as 170 head of cattle at once. Vaala boasted that he was able to feed twice as many animals in twelve minutes as he used to feed in three hours. The saved labor amounted to an estimated \$2,000 per year in 1959.³³

The labor situation only worsened for farm families in the late 1950s and early 1960s, highlighting the importance of automated materials handling. Jim Cochran of Dallas County complained that “Good, dependable hired help is getting harder to find. So,” he concluded, “the best way for me to sidestep this labor bottleneck was to mechanize my feeding.” Carl Feucht of Lyon County acknowledged that feedlot mechanization did not always provide a maximum return on investment but it was preferable to depending on the vagaries of the labor market. Feucht maintained that mechanization “sure is more dependable than the hired labor situation these days.” Norman Erickson of Hamilton County used an auger system to

³³ Dick Hagen, “Mechanize your feedlot?,” *Wallaces Farmer*, 17 October 1959; Pat Kellogg, “He feeds 170 head in 12 minutes,” *Successful Farming*, February 1959.

move feed from a mill in his corn crib to an automated feed operation. “Five years ago,” he explained in 1960, “we installed the 5-inch auger to move grain and feed fifty-three feet to the feeding setup.” But when he had to haul feed on a temporary basis during the winter after years of using the automated system, it became apparent “how much work the auger had been saving us.” Erickson’s farm had a capacity of between 200 and 300 cattle, and he kept all of them on the dry lot. He claimed that his elaborate, electrified feeding system saved him the expenses of hiring an extra worker.³⁴

Farmers even designed their own feeding systems. Joel Midden of Lyon County endured years of back trouble and decided “I had to start using my head instead of my back.” Midden combined a gasoline engine, parts from a manure spreader and a junked car to create a feed mixer-carrier that would allow him to feed eighty head of beef cattle. Midden dumped grain and silage into the spreader. The manure spreader beaters mixed the feed as the moving bed of the spreader pushed the feed out of the machine. An old car-top over the beaters kept the feed from being thrown out of the cart, forcing it instead to fall into the feed bunks below. The mixer-carrier moved out over the feed bunks on a set of parallel tubes, or rails, just as train moved along tracks. The automobile wheels (without tires) kept the vehicle on the rails. Midden built another similar mixer-carrier for his brother-in-law. One Hardin County farmer devised a ninety foot retractable bunk that moved on rails. Inventing these systems allowed farmers to use their own time during slower winter months to minimize capital investment.³⁵

³⁴ Dick Hagen, “Mechanize your feedlot?” *Wallaces Farmer*, 18 February 1961; “Saves labor with mechanized feeding,” *Wallaces Farmer*, 1 April 1961; “Let augers do the job,” *Wallaces Farmer*, 3 September 1960; *Successful Farming Materials Handling, Third Edition*, circa 1960. Dale O. Hull Papers.

³⁵ “Feed cattle with less work,” *Wallaces Farmer*, 15 December 1956; “Here’s a new idea in feeding,” *Wallaces Farmer*, 4 April 1959.

In some cases, farmers completely redesigned the layout of their farmsteads. Existing buildings were part of the reality farmers lived with, even when those buildings were not designed with automated feeding in mind. In 1965 Russell Frandson of Story County reworked his farmstead that was initially laid out in 1939. He tied the corn crib and a cluster of three small silos together with overhead augers, allowing him to draw on any one of the silos for mixing silage with grain. He tied another silo into the system with a second overhead auger. The lines met to carry feed into two long feeder augers that ran perpendicular to the main line. The two long feeder augers deposited the feed into one 144 foot bunk and one 105 foot bunk, enabling him to feed up to 500 head of cattle.³⁶

There were significant costs to these new systems, although for many farmers who already invested in silos and feedlots in the years before automation, the cost of mechanizing was not daunting. According to one 1959 advertisement, augers and motors cost approximately \$700 for farmers who fed fewer than 300 head of cattle. Three years later Robert Peet of Jones County reported that he invested \$700 for an auger system. The augers were the least expensive part of the operation. Costs ranged from \$1.50 per foot for four inch diameter augers to \$2.00 per foot for six inch diameter augers. Jim Cochran's 160 foot bunk cost about five dollars per foot, or a total of \$800. This figure included the bunk, concrete for the cattle to stand on while they ate, and the crushed rock path to keep the tractor and self-unloading wagon out of the mud. In 1959 Marvin Fernow of Linn County invested approximately \$1,750 in electric motors, auger, and tubing to feed his 435 cattle in less than twelve minutes. Silo unloaders cost from \$1,000 to \$1,500 in the late 1950s. These expenses

³⁶ Phil B. Jones, "He built a '65 Feed Lot around a 1939 Barn," *Successful Farming*, September 1965.

would have been unthinkable to an earlier generation, but for farmers confronted with high labor costs, the expense was reasonable.³⁷

Costs were appreciably higher when farmers created entirely new systems. When farmers created an operation from the ground up rather than simply converting an existing feedlot they confronted the expenses of erecting new silos, feed bunks, sheds, and fenced lots. This was the kind of set-up that Lawrence and Gordon Hauck of Humboldt County installed around 1960 to fatten two herds of 350 cattle every year. The most important labor saving element of their operation was a circular feed bunk with an overhead swinging auger to carry silage and feed from the corn crib and three new concrete silos that were eighteen feet wide and fifty feet tall. This system cost \$15,000, including concrete feed bunks and concrete floor to keep cattle out of the mud.³⁸

These kinds of expenses were not intimidating to farmers who had a high tolerance for risk. In 1962 Bob Anson of Marshall County invested \$25,000 in an automated beef feeding operation for 750 head of cattle and 700 feeder pigs per year. The new farm layout included two, twenty foot wide by sixty foot high silos with 100 foot auger bunks. Anson managed these animals and farmed 700 acres all with the help of only one hired man. In spite of low cattle prices in the mid 1960s, Anson justified the expense of his operation by comparing the first cost of the feedlot and buildings to the cost of hired labor. "If I didn't have my beef feeding equipment, I'd need another man," he explained. "In ten years, his wages would match my feedlot investment which should give me at least 20 years use."

³⁷ Eugene S. Hahnel, Stilbosol advertisement, *Successful Farming*, December 1959; "Augers can speed choring time," *Wallaces Farmer*, 3 March 1962; "Let augers do the job," *Wallaces Farmer*, 3 September 1960; Hagen, "Mechanize your feedlot?"; "Silo unloaders".

³⁸ "They mechanized their feedlot," *Wallaces Farmer*, 6 April 1963.

Calculated this way, Anson was able to stretch his investment in capital improvements over twenty years instead of spending the same amount of money on labor over ten years.³⁹

Even farmers who were willing to invest large sums of money into farmstead modernization exercised caution. The Berghoefer Livestock and Grain Company, located in Franklin County, was large family enterprise that expanded incrementally in the 1960s. The Berghoefers counseled careful planning based on observation of existing facilities and other operations combined with expert advice. They expanded from 400 head capacity to 800 head capacity in three years. After planning and research, “put it up a piece at a time to make sure each thing pans out as you go along---missteps are easier to correct early.” Farmers who committed to this kind of rapid growth needed to plan out every aspect of the operation.⁴⁰

Experts encouraged farm families to put pencil to paper and determine just how profitable automated feeding could be on their farms. The most variable cost, as noted, was labor. If farmers paid their labor low wages, then it was potentially more profitable to continue hand feeding. If wages were high, then pushbutton techniques were more attractive. Similarly, if a farmer spent a lot of time feeding animals, that labor cost would add up more quickly than if a farmer spent comparatively little time in feeding. In 1961 *Wallaces Farmer* published the results of a Purdue University study on the costs of labor and the profitability of automated feeding. The study indicated that if a farmer could save an hour per day over the course of two feedings and paid either himself or a hired man \$.75 per hour, that farmer could afford to invest \$1,750 in mechanized feeding. But a farmer who paid \$2 per hour

³⁹ Wayne Messerly, “Automation lets him feed more cattle,” *Wallaces Farmer*, 5 March 1966.

⁴⁰ “Piece by piece they built a modern feedlot,” *Electricity on the Farm*, June 1967, Hull papers.

could afford to invest \$4,800 to save an hour per day. These calculations indicated just how rapidly labor costs could add up over the course of a year and proved that capital investment could help farmers. One father-son partnership from O'Brien County made the claim that their automated system was more reliable than hired men. In the years since they installed their system they only missed one feeding. "Not many hired men can make a claim like that," they asserted. "Making do" or just getting by with hand feeding was not an attractive option for farmers who hoped to continue farming in the postwar world.⁴¹

Automated feeding not only helped farmers deal with the cost-price squeeze by cutting labor costs but also by expanding production. Prices for farm products were often increasing, just not as rapidly as costs. This pressure made standing still in terms of farm practices a risky position. Expansion was one attractive solution to the problem of low prices. Fred Schmidt, a cattle feeder from Clinton County, made an educated guess about the impact of pushbutton techniques on feeding trend in the state. "If it weren't for mechanization in the feedlot," he asserted, "I bet there'd be one-third less cattle on feed" in the state. "If we had to go back to the scoop and basket, I know we'd be feeding fewer cattle than we are," he declared in 1961. Schmidt's analysis may have involved some guesswork, but it reflected an important truth about the 1950s. Automated materials handling meant expansion for most farmers. Dairy farmers used automated materials handling and new milking parlors to expand production to offset shrinking returns. Similarly, beef producers could automate to expand. When it took as much time to feed fifty cattle by hand as it did

⁴¹ "Saves labor with mechanized feeding," *Wallaces Farmer*, 1 April 1961; *Operation Feedbunk*, 8mm (Iowa State College Film Production Unit, 1959), Special Collections, Parks Library, Iowa State University.

300 by machine, the investment in automation was something that could pay for itself in a matter of years.⁴²

Automated feeding also made it easier for people with less skill or physical strength to handle routine feeding. Workers who were older, partially disabled, or teenaged were less expensive than workers in their prime who often had families to support. Carl H. Goeken's system on his Cass County farm was designed to help him do in thirty minutes what it previously took two men half a day to do. "I wanted to have a setup that could be operated by a single hired man or a 'retired' person," suggesting that he not only cut labor costs, but could also have someone who was less physically fit do the work. Even hired men testified to the relative deskilling of farm labor. Goeken's hired man claimed that the system was not complicated. "Main thing," he explained, "is just to push the buttons in the right order so that the wrong thing doesn't happen." Pushing buttons in sequence required little brawn or brain power. The demand for physically powerful farm workers decreased as mechanization of feeding increased. Ted Pellett of Cass County claimed that the ease of pushbutton was a welcome change from the scoop shovel. According to Pellett, "It's nice to stand inside and feed cattle when it's pouring down rain or a blizzard." Now farmers who fattened livestock could enjoy the creature-comforts that dairy families and workers began to appreciate when they converted to modern milking parlors.⁴³

Despite the attention farm journalists devoted to the benefits of mechanized feeding, it remained a practice of a small minority of farmers through the 1960s. In 1964 49 percent of farmers in Iowa reported feeding cattle, while only half of those reported feeding cattle

⁴² "Outside Stuff," *Wallaces Farmer*, 4 March 1961.

⁴³ Newt Hawkinson, "Mechanized feeding for beef cattle," *Wallaces Farmer*, 21 March 1964.

year round. This 25 percent of Iowa farmers were the only ones who could justify the expense of automated feeding. Of the farmers who fed cattle, 9 percent used fence-line feed bunks and slightly less than 7 percent used power conveyors such as augers for feeding. The most popular form of labor saving device in cattle feeding was the self-unloading wagon. One fourth of all cattle feeders used these wagons to fill feed bunks either along fence lines, or, more commonly, in the middle of feedlots.⁴⁴

Even though a minority of farmers fully automated their feedlots, this minority played an increasingly important part in Iowa agriculture. Over the course of the 1960s, the number of feedlots declined, but the share of statewide cattle production of the largest of those feedlots increased. Iowa led the nation in the total number of feedlots for cattle as well as numbers of cattle marketed. In 1969 there were 44,002 feedlots of all sizes in the state, down from 46,000 in 1968. The decline was in the number of feedlots with less than 1,000 head of cattle, although the remaining feedlot operators with less than 1,000 head actually marketed more cattle in 1969 than they did in 1968. While the number of lots with more than 1,000 animals did not increase from 1968 to 1969, the share of total production for those lots increased slightly. In 1968 the largest feedlots marketed 8 percent of the total number of cattle marketed in the state. In 1969 the largest feedlots marketed 9 percent of Iowa cattle. The shift of one percent from one year to the next did not constitute a trend by itself, but the shrinking number of small scale producers most was a major shift in production.⁴⁵

It is almost impossible to know anything about the motivation of the 2,000 smaller-scale operators who quit raising cattle from 1968 to 1969, but the example of dairying is

⁴⁴ "Cattle feeding methods vary widely in Iowa," *Wallaces Farmer*, 18 September 1965.

⁴⁵ "Trend toward larger cattle feedlots continues," *Wallaces Farmer*, 28 March 1970.

instructive. Dairy farmers shifted operations in large numbers in the 1950s rather than invest in new equipment that made expansion possible. Some continued for a while, but they could not last long producing for a lower priced Grade B market. There were many thousands of small scale operators who continued to raise beef profitably, but there were also many who found that the capital requirements of livestock production were too steep to continue, just as most dairy farmers had realized. Those who stayed in farming concentrated on other tasks such as raising cash grain. Many may have quit agriculture due to age or to pursue opportunities elsewhere. But there was no escaping the fact that in a period of steady or declining prices, those who produced at the lowest cost were in the best position to survive.

While automated feedlots met the needs of the growing number of farmers who finished large numbers of cattle, confinement feeding was the ideal image of industrialized, pushbutton agriculture in the late 1960s. From feeding to manure removal, almost every step of the process of helping animals reach market weight could be mechanized. This was a change from the ways farmers raised hogs up through the mid twentieth century. Although nineteenth century settlers frequently let their hogs roam for much of the year, fencing fields to keep animals out rather than constructing fences to keep animals in, by the twentieth century animals were frequently enclosed on Iowa farms. As population density increased and a handful of farmers began investing in improved breeds of livestock, communities passed new fence laws to keep animals in to help control breeding. Throughout most of the twentieth century, most farmers grazed hogs on pasture part of the year; they grazed them in cornfields with cattle in the fall, and kept those animals in lots adjacent to the corn crib for fattening before marketing. This way, farmers converted corn, a low priced commodity, into higher priced pork and lard. Hogs did not require much work when they were on pasture or

“hogging down” a cornfield. Farmers needed to haul drinking water but the animals typically thrived on the pastures and in the cornfields. When the hogs were enclosed in lots, they required much more work. Farmers hauled water in addition to feed. But this traditional system of feeding hogs would change after 1950. First with hogs and then with cattle, confinement feeding represented the ultimate expression of industrialization in livestock production.⁴⁶

In the early 1950s confinement feeding simply meant restricting hogs to a concrete floor. This kind of confinement was not the most popular method of raising hogs. In 1955 only 29 percent of Iowa farmers raised hogs on cement. Most farmers did not believe it was practical to confine animals. There was just too much risk of disease on small, cement floored lots compared with feeding hogs on pasture. As one Ida County farmer stated, “It’s healthier to have ‘em out on pasture...” The lots provided a disease-rich environment, with hogs in close quarters much more susceptible to communicable diseases than those on more extensive pastures.⁴⁷

But there were two major developments that made confinement feeding more practical in the mid 1950s. Antibiotics were available to prevent or control the outbreak of disease. Furthermore, when administered in sub-clinical doses, those antibiotics stimulated growth, helping to speed animals to market weight faster than animals without antibiotics (see chapter four). The other trend was the increase in land prices. As land prices rose, in part due to the competition of expansion-minded farmers, farmers needed to obtain maximum returns from each acre. Pasture grazing hogs on large tracts was simply did not

⁴⁶ For a general discussion of changes in hog housing, see Chris Mayda, “Pig Pens, Hog Houses, and Manure Pits: A Century of Change in Hog Production,” *Material Culture* 36 (Spring 2004): 18-42.

⁴⁷ “Confine ‘em or Turn ‘em out?,” *Wallaces Farmer*, 19 February 1955.

pay returns as high of returns as other uses for that land such as growing crops. Arnold Kolder of Butler County stated bluntly that “My fields are worth more to me in crops than in pasture.” Dairy and beef farmers learned that it was more profitable to keep animals on a lot and haul feed to them than to let the animals graze because the rate of gain was faster with controlled feeding. As land values appreciated, farmers wanted to get the most possible production from that land, which often meant raising more livestock feed or a high return crop such as soybeans. Confining hogs to cement feeding areas allowed farmers to get the most from their land. It also allowed farmers to market hogs throughout the year instead of selling in January and February when everyone else sold hogs and prices were at their lowest point of the year.⁴⁸

The disadvantage of confinement feeding was the high labor requirement. Instead of letting hogs graze for themselves and deposit their manure across a large acreage, farmers who confined hogs to concrete lots needed to haul feed and move tons of manure, both labor intensive jobs. Oscar Torneten of Pottawattamie County emphasized that it not only took labor to move the manure but it also took time to clean and disinfect feeding equipment used in the lots to prevent the spread of disease. Confinement feeding meant large numbers of hungry mouths and tons of manure. It was not possible to continue to use the scoop shovel and manure fork with confinement feeding.⁴⁹

A small number of farmers experimented with automation and architecture to reduce the labor demands of confinement feeding. In 1959 the definition of confinement changed. Instead of simply confining hogs to lots with hard surfaced floors, confinement came to mean

⁴⁸ “Which way with hogs?,” *Wallaces Farmer*, 18 May 1957.

⁴⁹ “Raise hogs on pasture or concrete?,” *Wallaces Farmer*, 19 April 1958.

confining hogs to pens within a building. These pole-framed buildings were divided into pens of varying size. Max Bailey of Story County constructed a new building along these lines in 1957. A feed mill and storage occupied one end of the rectangular building. An auger system carried feed down the center of the length of the 176 foot long building, depositing feed along one side of the eighteen pens. These sixteen by eighteen foot pens included an automatic watering device for fresh drinking water. Lengthwise along the exterior walls there were dunging alleys. During normal operations, a portion of the alleys were included in each pen, but movable gates could close off each pen and open the alley from one end of the building to the other. A tractor loader could scrape the manure off the floor and push it into a pit at one end of the building. The new style of confinement feeding was a completely integrated system designed to handle large numbers of animals with minimal labor.⁵⁰

Manufacturers even offered prefabricated confinement feeding structures. The “Bacon Bin,” manufactured by a company in Kansas City, Missouri, resembled a steel grain storage bin with corrugated siding and conical roof. The interior included two levels of pens arranged around the circumference of the structure, which could be rigged for farrowing or finishing hogs. In addition to automated feeding, watering, waste removal, the building was completely insulated and included a ventilation system temperature control. William Conover of Marshall County installed a Bacon Bin on his farm in 1964, one year before the structures were on the market, claiming that it was an inexpensive structure to build and that his hogs were gaining weight rapidly with minimal labor costs.⁵¹

⁵⁰ “How to make hog finishing easy,” *Successful Farming*, March 1959.

⁵¹ “New concept in hog housing,” Farm Business Report, *Wallaces Farmer*, 21 March 1964.

Iowa farmers substituted capital for labor in livestock operations. One Carroll County farmer constructed a thirty-six by 100 foot building with twelve pens to accommodate up to fifty hogs per pen. This farmer, like Max Bailey, could feed many more hogs with this kind of operation than would have been possible to feed with older systems. By investing approximately \$4,500 in materials and an undisclosed amount for labor, Mearl Pottroff attempted to produce a large number of hogs for the market as fast as possible. USDA economists estimated total costs for a 500 hog operation to be approximately \$10,000. Other farmers such as Don Goodenow of Ida County probably spent less to convert an old barn to a confinement barn even though he installed separate augers for moving feed into the barn and manure out of it. He claimed that he spent approximately one hour per day to chore and inspect 400 hogs. E. L. Quaife, an Iowa State College swine specialist, believed that these new facilities were best suited for farmers who were willing to raise more than 500 hogs per year. Expert farmers, bankers, and extension professionals encouraged farmers who kept small herds to keep hogs on pasture to keep production profitable. With large investments and large scale production, confinement feeding was the choice of a few rather than that of the many.⁵²

Robert Hamilton of Hardin County was one of those rare farmers who moved his animals off of pastures and into buildings. Hamilton not only confined the hogs he planned to sell but also his breeding herd. He constructed a \$20,500 farrowing house in 1957 and in 1959 invested \$4,000 in a confinement building for finishing hogs. The automatic feeders, water system, and manure gutters were not unique features. Hamilton's system was unique

⁵² Dick Hagen, "What housing for feeder pigs?," *Wallaces Farmer*, 18 April 1959; Newt Hawkinson, "Confinement or pasture for hogs?," *Wallaces Farmer*, 7 April 1962; "Augers move both feed and manure," *Wallaces Farmer*, 21 July 1962; "Timely Tips," *Wallaces Farmer*, 4 August 1962.

because he kept hogs inside all year long. Hamilton surmised that the labor savings that farmers realized by housing animals inside for part of the year could be realized the entire year.⁵³

Beef producers also wanted to realize the improved rate of gain that hog producers enjoyed from confinement feeding. Some of them already automated their feedlots, but few farmers provided shelter for their beef cattle. Cattle only needed shelter in the most extreme weather, but providing some kind of shelter would help them convert more of their feed to weight gain rather than keeping warm. For most farmers for most of the twentieth century, however, any potential gains were not worth the expense. Farmers who constructed shelters used simple pole sheds. A Taylor County farmer did not have any structures designated as cattle shelter. He explained, "My cattle spend the winter in the grove and around the buildings." In the 1960s a small group of cattlemen and farmers hoped that they could get more gain by controlling the environment for livestock, just as hog farmers had begun to do in the 1950s.⁵⁴

Farmers who confined beef animals could minimize the extremes of temperature while gaining all the benefits of automated feeding, watering, and manure removal. The most publicized cattle confinement in the state belonged to Jim Rock of Kossuth County. Rock constructed his seventy-two by 160 foot building in 1961 at a cost of \$1.25 per square foot, including labor charges. He used cornstalks and corn cobs for bedding over a concrete floor for 300 cattle. The bedding helped keep the cattle out of the manure and dry, while the packed manure generated heat in the winter time. A fence line bunk along one side of the

⁵³ John Harvey, "3 Buildings, 1,200 Hogs---All Under Roof," *Successful Farming*, April 1965.

⁵⁴ "Shelter for beef can boost gains," *Wallaces Farmer*, 1 November 1958.

building allowed for automated feeding. In 1962 Rock reported that he was pleased with his operation, but would not know how successful it really was until he was able to use it for at least another year.⁵⁵

After several years of operation, Rock and other farmers who chose confinement praised the system. Rock moved cattle that weighed from 850 to 900 pounds into his building and kept them there until they were ready for market at from 1,050 to 1,150 pounds. Rock concluded that the barn “really pays off in this final push.” His records indicated that cattle in his outside lots gained about .10 pounds per day less than his cattle in confinement. That small margin, spread over 300 cattle every year for several years added up quickly. After nine years of operation he calculated that the barn paid for itself in five years. Robert and Roger Clause of Grand Junction agreed that confinement feeding paid. They built their facility in 1968 when they hosted the Farm Progress show. While they would not divulge the specifics on the profitability of their operation, they maintained after two years of operation that the building would pay for itself in ten years or less. Some of the most persuasive evidence that beef confinement could work was the fact that Rock’s brother-in-law copied his system in 1969 and that in 1970 Rock planned to build another barn like his old one.⁵⁶

In spite of Rock’s success and willingness to invest in another confinement building as the 1970s began, there was no consensus among farmers that confinement was the best solution for finishing cattle. A new partial confinement operation opened in 1970 near Aurelia in Cherokee County to accommodate 12,000 steers. This was the exception to the rule, however. Farmers who voted with their money voted against the new system. There

⁵⁵ Chester Peterson, Jr. and William J. Fletcher, “Cattle feeding goes inside,” *Successful Farming*, September 1962; Newt Hawkinson, “Outside Stuff,” *Wallaces Farmer*, 7 July 1962; “Feeding beef cattle in complete confinement,” *Wallaces Farmer*, 2 February 1963.

⁵⁶ “Beef Confinement,” *Successful Farming*, May 1970.

were fewer cattle confinement operations for cattle than there were for hogs. H. L. Self, an animal scientist at Iowa State University argued that confinement feeders needed to earn at least sixty dollars more per steer than those who did not use any shelter at all. Self proclaimed that that was a difficult goal to reach, implying that most farmers would be wise to continue traditional feeding practices.⁵⁷

Experts still played an important role in promoting confinement feeding for hogs and cattle. Livestock specialists at Iowa State and the extension staff studied the proper size of pens, construction materials, ventilation, and arrangement for manure disposal systems. Some of these experts were on hand at the 1962 Farm Progress Show, sponsored by *Wallaces Farmer*. In 1962 Iowa State University dedicated its exhibit to hog production. The “Pigneyland” exhibit focused on the ideal type of hog carcass for modern consumers, selecting proper breeding stock to obtain these ideal animals, and the architecture and equipment needed to raise hogs from farrowing to finishing. In the finishing building, the emphasis was on pens with slotted floors for keeping pens free of manure. Extension specialists were on hand to answer questions from interested farmers. Crowds were always large for these expositions, but large crowds and interest in learning more about the details of new technology did not indicate that a majority of farmers were willing to commit to the new technology.⁵⁸

The growth in the number of farmers who raised hogs in confinements was slow during the 1960s. In a 1966 poll of Iowa hog farmers only 2 percent of respondents stated that they raised hogs in buildings with insulation, ventilation, and automated feeding and

⁵⁷ John Dorr, “Iowa’s Largest Feedlot: Pampered Beef, Inc.,” *Iowa Agriculturist*, Winter 1972; “Beef Confinement.”

⁵⁸ “Building better hogs,” *Wallaces Farmer*, 1 September 1962.

manure handling systems. Farmers still reported good luck with pasture systems, contending that they kept animals on clean ground and they did not have to do any manure hauling. Most of the interest in getting into modern confinement feeding was by farmers under the age of fifty. Nine percent of this group was interested in confinement feeding while only 2 percent of the over aged fifty group indicated any interest in pursuing it. A majority of hog producers continued to use the pasture system. There were many farmers who profitably raised several hundred head of hogs on pasture during the 1960s. The handful of farmers who chose to use confinement feeding during the 1960s suggests that farmers regarded it as unproven, unwise, or unnecessary.⁵⁹

Farmers who continued to farm with hogs on pasture explained their decisions to stay with their system. Some farmers simply liked the way they did business. A farmer from Plymouth County asserted that he would never abandon pasture feeding. "I raise over 500 head of hogs in the field and it's simple and easy." For others, an investment in pasture feeding meant that farmers would want to use that system as long as it was intact. Roger Shaff of Clinton County converted to confinement feeding, but insisted that it was not for everyone. Farm families with capital and little labor could make it pay, "But if you have enough labor and not a lot of capital, there's no advantage." Age was also an important concern, as indicated by the 1966 poll cited above. "I'm not as young as I used to be," explained Don Kruse of Floyd County, "and I can't afford to invest that kind of money at this stage of the game." Renters were also discouraged from investing the thousands of dollars in permanently situated confinements, although there were a few exceptions. As one renter

⁵⁹ "Do you grow hogs in confinement," *Wallaces Farmer*, 8 October 1966; Hawkinson, "Confinement or pasture for hogs?"

commented, “It would make a difference too, if you were just in the hog business. I feed about 140 head of cattle a year too, and I have a lot of money tied up in them.” This commitment to diversification was an important anchor for farmers who hoped to ride out low prices for one commodity with receipts from another commodity.⁶⁰

The high first cost of constructing a confinement system could pay off, but making that kind of investment necessitated expanding production. A farmer from Washington County explained it this way in a response to an inquiry from a producer who wanted to continue raising a herd of 500 hogs but was unsure about whether or not to invest in a confinement or continue raising hogs on pasture. “...Building a hog confinement building, in addition to your present equipment, would not be profitable unless you increase your hog production.” While one Iowa farmer in twenty raised more than 500 hogs per year, the largest group of producers, 28 percent of farmers, raised between 100 and 200 head. Furthermore, the percentage of sales of hogs for producers in this category increased over the course of the early 1960s. The growth in this group suggests that most farmers liked raising hogs on pasture with family labor and that they were more risk averse than the handful of farmers who invested in confinements.⁶¹

Farmers who turned to confinement feeding prized the potential for expansion. These risk-tolerant farmers were prepared to invest in systems that would allow them to ride out future price shocks. As a Boone County farmer observed about confinement feeding in 1965, “Oh, it’s coming, all right. There aren’t too many in our area yet---but it’s coming.”

Farmers who used confinements believed in the future of this new system. In the mid 1960s

⁶⁰ “Do you grow hogs in confinement”; Ken Hofmeyer, “Producers’ views on hog growing systems,” *Wallaces Farmer*, 6 February 1965.

⁶¹ “Timely Tips,” *Wallaces Farmer*, 19 December 1964; “Who’s raising all our hogs?,” *Wallaces Farmer*, 20 February 1965.

Carl Frederick of Johnson County raised 1,600 hogs per year. He maintained that farmers needed to be fatten hogs year round to make their investments in buildings and equipment pay off. To speed the rate of gain, confinement was absolutely necessary. In explaining his vision for the future, Frederick explained “I feel that hogs will be in controlled buildings--- they’ll never leave buildings from birth to market.” By removing variables such as fluctuations in weather and controlling feeding, industrial style production would allow farmers to be more profitable than producers who used pasture systems.⁶²

Industrial style production was not free of problems, however. Although the idea behind confinement feeding was to speed weight gain in animals by removing variables that caused stress, such as weather conditions, confinement caused its own stresses that were reflected in animal behavior or even illness. Veterinarians reported that farmers who used confinements saw more problems with aggressive behavior. Specifically, hogs would bite the tails of other hogs. The concrete floors took their toll on animal health, causing sore feet and legs. Some veterinarians argued that mineral deficiencies in confinement-raised hogs contributed to the tail biting and lameness, and that farmers needed to increase the level of salts and trace minerals in the hogs’ diet. If ventilation was not adequate, the dust of feed and waste as well as airborne pathogens could cause respiratory ailments. One Oelwein veterinarian summed up the situation by observing that “practically the same disease problems [exist] in confinement as in pasture systems, except that I find more of them and more that are difficult to treat.”⁶³

⁶² Hofmeyer, “Producers’ views on hog growing systems,”; Carl Frederick, “How I Breed and Feed For No. 1 Hogs,” *Successful Farming*, July 1965.

⁶³ “Hogs in confinement need top management,” *Wallaces Farmer*, 25 January 1969.

The solution to these behavior and medical problems was for farmers to improve their herd management. On the pasture system, hogs took care of themselves as long as farmers provided feed and water. Confinement feeding was different. Farmers saved labor, but they also needed to pay closer attention to small details that could be magnified by the large numbers of animals and scale of confinements. This was a substitution of highly skilled labor for skilled labor. As one beef confinement feeder maintained, “There’s a lot more to it than just pushing buttons.” Farmers always had to watch their herds, but with the increased investment in buildings and automated systems, they now had to pay even more attention to the details. In some operations, workers and visitors showered before entering livestock areas. They even installed clothes washers and dryers to prevent pathogens from infecting the herd or leaving the property. It was critical to monitor nutrition, equipment, ventilation, health, and waste management. Farmers who did not risked seeing one small problem magnified many times into a major problem.⁶⁴

Waste management was the one detail that assumed monumental importance to confinement feeders. Large-scale confinement feeding brought a large-scale manure problem. Hogs on pasture were spread out over many acres, depositing urine and feces across a large area. By contrast, hogs in confinement buildings deposited their waste in a small area. The amount of waste excreted by one hog on full feed in confinement was staggering. A one-hundred pound hog that consumed approximately 4.7 pounds of feed per day produced 4.3 pounds of solid waste per day and 1.06 gallons of liquid waste. As the hog reached market weight of 250 pounds it consumed 8.2 pounds of feed per day and excreted

⁶⁴ Farm Progress Show confinement beef barn pleases owners,” *Wallaces Farmer*, 14 March 1970; “Confinement setup for feeder pigs,” *Wallaces Farmer*, 27 January 1968.

7.8 pounds of solid waste and 2.65 gallons of liquid waste per day. Animals in a 250 hog they generated almost one ton of solid waste and approximately 662 gallons of liquid waste per day just before they were sold. This was an unprecedented amount of waste to handle.⁶⁵

Farmers who practiced confinement feeding needed new ways to deal with massive amounts of manure. They constructed manure pits under the confinement buildings to collect solid and liquid waste. Large scale operations that included automated feed, water, and ventilation systems also included automated manure handling. Herman Tripp of Greene County constructed an underground pit made of concrete blocks five by six by eight feet to hold his hog manure. Each week he used a four inch auger to transfer the manure from the pit to a spreader wagon to carry the waste to his fields. These pits required regular labor to clean. If they could not be emptied for some reason the farmer faced a manure back-up of industrial proportions.⁶⁶

The manure lagoon was a labor saving solution to the manure problem. A lagoon was simply a large basin of variable width and depth to hold animal waste and to allow the waste to decompose before it would be removed and used as fertilizer. There were two types of lagoons, aerobic and anaerobic. Aerobic lagoons included enough water that bacteria that used oxygen could survive, while anaerobic lagoons were so concentrated that only bacteria that lived in environments without oxygen could thrive. While research from the mid 1960s indicated that most lagoons had both aerobic and anaerobic qualities, experts and farmers

⁶⁵ "Swine Equipment Plans" Cooperative Extension Service, Iowa State University, Ames, Iowa. (Ames: Midwest Plan Service, Iowa State University, 1959), Records of the Midwest Plan Service. In 1965 livestock in Iowa created approximately 90 to 100 million pounds of manure, half of which was deposited in pastures while the other half was deposited in enclosures. Observers noted that the proportion of the manure deposited in enclosures would increase rapidly with the rise of confinement feeding. George M. Browning, "Agricultural Pollution—Sources and Control," in *Water Pollution Control and Abatement*, eds. Ted L. Willrich and N. William Hines (Ames: Iowa State University Press, 1967), 159.

⁶⁶ Dick Hagen, "Easy manure handling," *Wallaces Farmer*, 21 November 1959.

believed that the wide, shallow lagoons were aerobic while the deep lagoons were anaerobic.⁶⁷

One of the first manure lagoons constructed in Iowa was at the Northeast Iowa Swine Testing Station in Chickasaw County which opened in 1960. The purpose of the testing station was to help farmers make the transition from lard-type hogs which were falling out of consumer favor to meat-type animals. Farmers could have their boars raised at the station where they would be fed a standard diet and closely monitored for rate of gain, thickness of back fat, and ratio of feed conversion to meat. At the end of the test period the station conducted a sale of animals that met the minimum standards of the station. The farmer reimbursed the station for the number of animals that had been raised there. Approximately 350 animals were on site at any given time, which meant that waste would accumulate quickly. To handle hog waste and to save labor, station managers installed the new lagoon technology.⁶⁸

In the early 1960s farm families who practiced confinement feeding began to experiment with lagoons, too. Robert Schrier installed a sloping gutter to carry manure to his lagoon on his Cass County farm. Every day he scraped the hog waste into the gutter and every week or ten days he removed the plug on the gutter and gravity would carry the backed up waste through an eight-inch tile line into his lagoon. This technique allowed him to remove manure from a thirty-eight by eighty foot building that housed between 250 to 300 hogs. Farmers who had manure collection pits had to drain those pits on a regular basis depending on the size of the holding tank. Sometimes it was every week, other times every

⁶⁷ Newt Hawkinson, "What they're learning about manure lagoons," *Wallaces Farmer*, 18 April 1964.

⁶⁸ For more on the testing station, see William Colgan Page, *Leaner Pork for a Healthier America: Looking Back on the Northeast Iowa Swine Testing Station* (Iowa Department of Transportation in cooperation with the Federal Highway Administration and the State Historical Society of Iowa, 2000), 8-9.

few months. By contrast, farmers with lagoons were free from the regular and frequent round of moving manure.⁶⁹

Experts played a larger role in farming operations as farm families attempted to deal with waste. With the large sums of money involved, sometimes as much as tens of thousands of dollars for complete confinements, grain handling buildings, and waste management facilities, consultants could help farmers maximize returns on investment. The extension service and Midwest Plan Service provided free or low-cost advice and plans for farmers who wanted to construct waste handling lagoons or new buildings. The Midwest Plan Service was a consortium of agricultural engineers that drafted farm building plans and had headquartered in Ames. The Cooperative Extension Service conducted research on the effects of developments such as paved lots and shelter on the rate of gain in feedlot animals. By the late 1960s the publications of both extension service and the Midwest Plan Service showed the growing complexity of farm planning, especially for livestock manure.⁷⁰

By the end of the 1960s farmers who used the new manure handling technology confronted new problems that few people anticipated. The manure lagoons and manure tanks posed risks to farmers and livestock. There had always been discussions of the smell of manure pits and lagoons, but toxic gas was a real threat to safety. Methane and carbon dioxide were products of stored liquid manure that were released as farmers pumped out

⁶⁹ "New approach to manure handling," *Wallaces Farmer*, 2 June 1962; T. L. Willrich and John Harvey, "Easier hog-manure handling," *Successful Farming*, October 1962; Newt Hawkinson, "Manure lagoons," *Wallaces Farmer*, 6 July 1963.

⁷⁰ Page L. Bellinger, "Who will plan your system?," *Successful Farming*, January 1962. For an example of the kinds of publications available to farm families see: "An Outline For Planning Your Cattle Feeding Facilities," Iowa State University Cooperative Extension Service, Ames, Iowa, *A.E. 954*, January 1963, Hull papers; "Dairy, 1969 Edition, Midwest Plan Service Structures and Environment Handbook," abstracted from "Dairy Equipment Plans and Housing Needs" MWPS-7, 1968, Records of the Midwest Plan Service; "Two-Year Study of Environmental Effects (Shelter and Paving) on Feedlot Steers", Iowa State University Cooperative Extension Service, Ames, Iowa, *A. S. Leaflet R52*, October 1963, Hull papers.

manure pits. Without adequate ventilation, these gasses could asphyxiate humans and animals. Similarly, ammonia irritated respiratory tracts, while hydrogen sulphide could cause severe headaches and dizziness and even be fatal when present in large quantities. Lagoons also proved to be more complicated. Farmers could not simply create them and walk away. Experts advised farmers to create a series of lagoons, including an anaerobic lagoon for solid wastes to settle, followed by an aerobic lagoon. In some cases, experts recommended that the lagoons be lined with clay to reduce groundwater contamination. Furthermore, the thick sludge needed to be removed to keep the bacteria in the lagoon working to breakdown the waste. Sludge build up prevented decomposition of waste and potentially allowed waste to leach into groundwater or runoff into surface waterways.⁷¹

Agricultural engineers from Iowa State University corresponded with farmers and conducted occasional site visits to help farmers implement best practices. Extension agricultural engineer Dale Hull corresponded with several farmers and farm managers over the course of the 1960s, counseling them on the best practices they could use to minimize the runoff of manure into watercourses. From June through September of 1966 Hull and his fellow extension agricultural engineer, Ted Willrich, advised Rod Lorenzen, the manager of Group 21, Incorporated. Lorenzen initiated contact with Hull to find ways to prevent the contamination of Waterman Creek in O'Brien County. Hull recommended a collecting basin in which most of the runoff and solid waste would settle. Any overflow would go into a shallow, two to three acre oxidation pond. Three months after making these

⁷¹ "Handling Swine Manure," *Agricultural Engineers' Digest* (Ames: Midwest Plan Service, 1969), 3; "Anerobic [sic] Manure Lagoons," *Agricultural Engineers' Digest* (Ames: Midwest Plan Service, 1969), Records of the Midwest Plan Service; "Waste Disposal, 1969 Edition," *Midwest Plan Service Structures and Environment Handbook* (Ames: Midwest Plan Service, 1968), WD-14. Records of the Midwest Plan Service; Ted L. Willrich, "A Progress Report On Lagoons For Manure Disposal," n.d., circa 1960-61, Hull Papers.

recommendations, Hull and Willrich agreed to fly to Moneta “to take a good look at your manure disposal problems in connection with pollution control on Waterman Creek.”

Shortly after making the trip Willrich submitted an evaluation of the feedlot site and provided two contacts for engineering services.⁷²

Willrich advised the feedlot manager that waste runoff from thirty acres of lots and roads entered Waterman Creek. Willrich warned that “The Iowa Water Pollution Control Commission would no doubt look unfavorably on the continued operation of this feedlot until such time as a satisfactory runoff treatment system or runoff utilization system was installed.” Willrich’s recommendations were more complicated than those suggested by Hull in June. If the directors of Group 21 wanted to utilize their manure, they could prepare a system of settling basins and install a sprinkler system to carry and deposit wastes onto crop land. The other option was to create a treatment and disposal system, which would include a settling basin, an anaerobic lagoon, an aerobic lagoon, and finally, an evaporation cell for removing the last of the liquid from the animal waste. Furthermore, Willrich advised that the potential site for the abatement system should be studied. He noted that the site should be mapped, tests conducted for soil type and permeability, and flood elevations noted, all to prevent pollution. Lorenzen may or may not have had the power to implement these recommendations, but they represented the most current thinking of the experts about waste abatement.⁷³

Farmers were not of one mind about large-scale agriculture, waste runoff from feedlots, and the role of government regulation in stopping pollution. One third of all

⁷² Dale O. Hull to Rod Lorenzen, 14 June 1966, Hull Papers; Dale O. Hull to Rod Lorenzen, 15 September 1966, Hull papers.

⁷³ Ted L. Willrich to Rod Lorenzen, 27 September 1966 and “Statement for Group 21, Inc.—Re: Treatment and Disposal of Surface Runoff from Cattle Lots and Roads,” Hull papers.

farmers polled in 1968 about what should be done to curb runoff from feedlots claimed that they were not sure what the proper solution should be. Twenty-nine percent of farmers surveyed believed that only the large feedlots were responsible for any pollution problems and that the majority of farmers were not to blame and should not be regulated. Only 10 percent of farmers believed that pollution control measures were not needed for agriculture. There was agreement among farmers that feedlots were an environmental problem. Ninety percent of farmers believed that something should be done to control runoff pollution from feedlots, but they did not agree on who was most responsible for that pollution and who should be regulated.⁷⁴

The differing viewpoints reflected divisions within rural society. Opinion varied by age group, education level, and also by income. Almost half of farmers under the age of thirty-five wanted more pollution control, while only one third of farmers aged thirty-five to forty-nine wanted more control, and only 19 percent of those from fifty to sixty-four agreed with the need for more control. Approximately half of those who had attended some college favored having regulations on all livestock producers while only 21 percent of those with eight years or less of school agreed. Producers with the highest income favored regulation for all producers, while those with gross income between \$10,000 and \$20,000 believed that only the largest producers should be held accountable for pollution control. One respondent made a vague claim that nature solved pollution problems, while another argued that feedlot waste was not responsible for water pollution because “Water is purified after it soaks thru a few feet of soil.” Comments by farmers who favored regulation suggest that they were

⁷⁴ “Pollution control for cattle feedlots,” *Wallaces Farmer*, 11 May 1968.

motivated less by the issue of water quality for the people of Iowa and more by the “not in my back yard” concerns. One Greene County farmer exclaimed that “Something has to be done. These large feedlots are a stinking mess.” Similarly, another Greene County man complained about hog confinements, claiming that “these hogs raised in confinements are creating a problem for folks that [sic] have to live next door.” One farmer who raised hogs in confinement noted that his neighbors and friends made “kidding” comments about the smell of his farm. He was concerned that at some point they might do more than joke with him. The threat of regulation, court action, or retribution was becoming a reality of agriculture in the late 1960s.⁷⁵

Farmers with feedlots, just like factory owners, located their facilities close to water to help carry away wastes. This solution became less tenable in the 1960s. Members of the public and farmers were more sensitive to harm to ecosystems than they had been in the 1950s. Hull and Willrich were not the only ones counseling farmers to be cautious about establishing and operating feedlots and confinements. In the spring of 1968 the Iowa Water Pollution Control Commission called a series of public hearings in Iowa City, Ames, Atlantic, and Storm Lake to gather input to establish regulations for cattle feedlot waste disposal. The commission defined a feedlot as an enclosure or group of enclosures in which animal density was greater than fifty head of cattle per acre. Proposed regulations included requiring a permit for any operation of more than 1,000 head, that was close to watercourses, and if runoff or overflow from a manure lagoon or tank could flow into another’s property. While there were very few operations of more than 1,000 animals, the other criteria applied to many more farmers with feedlots. The Iowa Livestock Feeders Association, the Iowa Beef

⁷⁵ “Pollution control for cattle feedlots”; “Timely Tips,” *Wallaces Farmer*, December 1970.

Producers Association, and the Iowa Farm Bureau Federation opposed the proposed regulations. Feeders such as Durward Mommsen, chairman of the Clinton County Farm Bureau livestock committee, urged studying the issue for at least two years. Peter Vos, the Mahaska County Farm Bureau livestock committee chairman, reminded the public and members of the Water Pollution Control Commission that farmers earned only small profits, “Any more expenses,” he warned, “and we’re operating at a loss.” At the Iowa Pork Industry Conference in Des Moines, a USDA official advised farmers that they could be prosecuted in court for the way they did business. He cited examples from Texas and New York in which farmers faced tens of thousands of dollars in fees and damages from nuisance suits due to odor, noise, dust, and insects.⁷⁶

In 1969 the Iowa state legislature amended its Water Pollution Control Law to require the registration of some livestock producers in spite of the opposition of livestock producer groups and the Farm Bureau. Large-scale producers were the target of the new law, especially those considered to be at high risk for polluting surface waters such as rivers and lakes. Feeders with over 1,000 cattle and a population density of one animal for each 600 feet of lot were required to register. As proposed in 1968, the 1969 law also required registration for feedlots if there was a 3,200 acre watershed above the feedlot; if feedlot runoff or manure overflow entered an underground tile line, well, or sinkhole; or if the distance of the feedlot from a stream was less than two feet for every animal on the lot (500 head had to be at least 1,000 feet from the stream). It is unclear how many farms met these

⁷⁶ Tom Patrick, “Attack Proposed Feedlot Rules,” *Des Moines Register*, 24 April 1968; Al Bull, “Water pollution control hearings aimed at Iowa’s cattle feedlots,” *Wallaces Farmer*, 13 April 1968.

conditions and were required to register. There were 46,000 beef feedlots in the state in 1969, but only 135 farms claimed over 1,000 cattle.⁷⁷

In the fall of 1969 the state alerted feedlot operators to register. By July, 1970, fifty-two cattle feeding operations registered with the Water Pollution Commission and fifty-three more notified the group that they did not need to register since they did not meet the registration criteria. State Health Department inspectors viewed sixteen feedlots and determined that eleven of those had potential water pollution problems. One year later, a total of 147 cattle feeders and twenty-nine hog feeding operations registered with the commission.⁷⁸

The Water Pollution Control Commission continued to inspect feedlots and require permits in 1971. For farmers, this meant more government involvement in their business. A farmer who wanted to create a feedlot during the 1950s and 1960s simply built it. Now, the process involved agricultural experts and bureaucrats and took months before construction could begin. First, the farmer consulted with an Extension livestock specialist at a regional office for advice on planning the layout of the lot or confinement and the waste control systems. The next step was to contact the Iowa Geological Survey office in Iowa City to determine if the site had enough underground water and of the proper quality to sustain the planned operation. Soil Conservation Service specialists provided advice on designing the facility. The local Agricultural Stabilization and Conservation Service was the contact for federal matching funds through the Rural Environmental Assistance Program (REAP). After

⁷⁷ Iowa Water Pollution Control Commission, State Department of Health, *Water Pollution Control Progress Report, 1968-1969*, 12; Wil Groves, "Iowa's feedlot waste disposal law," *Wallaces Farmer*, 14 August 1971.

⁷⁸ Iowa Water Pollution Control Commission, State Department of Health, *Water Pollution Control Progress Report, July 1, 1969-June 30, 1970*, 17; Iowa Water Pollution Control Commission, State Department of Health, *Water Pollution Control Progress Report, July 1, 1970-June 30, 1971*, 17.

approval by the SCS, the farmer could then register with the Iowa Water Pollution Control Commission. For operations situated in a flood plain or if the livestock required more than 5,000 gallons of water per day, further registration was necessary with the Natural Resources Council. Registration and approved plans in hand, farmers could finally begin construction.⁷⁹

Public criticism, new laws governing feedlots, and concerns about future government regulation of water pollution from feedlots and confinements prompted some farmers to examine their operations. In 1970 Roy Olson of Dickenson County explained that he began to consider the problem of runoff control when some downstream neighbors saw some dead fish and speculated that they were killed by waste runoff from Olson's feedlot. Regardless of whether or not wastes from his farm contributed to the fish kill, Olson recognized the need to change. Arnold Olson of Emmet County had no abatement plan whatsoever. Solid and liquid waste simply washed off his feedlot into the county road ditch, through a culvert and into a nearby lake. Both farmers wanted assistance.⁸⁰

These farmers implemented new waste management plans to deal with their manure problems. Arnold Olson brought in local Soil Conservation Service workers and Ted Willrich of Iowa State University Extension. They designed a collecting basin at the base of the feedlot to hold five inches of runoff from his lot. As solids settled out, Olson pumped the liquid out and spread it on his fields. He also installed an eight inch diameter underground tile line to drain the liquids into his field. Olson planned to dredge the solids out of the basin

⁷⁹ "Planning feedlot waste disposal," *Wallaces Farmer*, 22 January 1972; Wil Groves, "Step-by-step plan for livestock waste control," *Wallaces Farmer*, 26 February 1972. The REAP program, formerly known as the Agriculture Conservation Program, provided up to \$2,500 to farmers on a 50 percent cost-sharing basis to speed farmers' acceptance of the new regulations. "Cost-sharing program gets pollution control emphasis," *Wallaces Farmer*, 13 March 1971; Wil Groves, "Livestock waste control systems," *Wallaces Farmer*, 22 January 1972.

⁸⁰ "These livestock feeders stop pollution," *Wallaces Farmer*, 24 October 1970.

every few years. Roy and Scott Olson fed 2,000 cattle on their twelve acre feedlot that was near the Little Muddy Creek in the Little Sioux River watershed. The Olson's faced the prospect of having the water from fifteen acres upland from their feedlot drain across the lot, picking up all the solid and liquid waste and carrying it downstream. To stop water from crossing the lot they installed a twenty-four inch tile line to divert this water before it crossed the feedlot. Water falling onto the feedlots themselves was also a problem. They constructed a collecting basin to catch water from the lot and small check dams along waterways to catch solids and let them settle out before the runoff continued to the basin.⁸¹

In 1970 Dale Hull and Stewart Melvin, another Extension Agricultural Engineer, traveled to Peterson, Iowa to inspect the farms of Don Plagman and Walter Ankerstjerne. Both farmers hoped to construct beef confinements on their respective farms. Melvin suggested that both farmers construct oxidation ditches to carry wastes into a series of two anaerobic lagoons. Melvin predicted that there would be a possible odor problem for a neighbor located approximately one quarter mile away from the proposed site at the Ankerstjerne farm. To prevent contamination at the Plagman farm Melvin suggested that the lagoons there should be banked and partially above ground due to the high water table.⁸²

Farmers who constructed these waste control systems expressed their desire to head off criticism, prosecution, and regulation as well as to be good neighbors. When Bill Conn of Kossuth County planned his 2,000 head feedlot in Kossuth County there was concern in the community that his livestock waste would drain directly into the nearby Des Moines River. Conn noted that a local women's group came to his farm to investigate and to see that

⁸¹ "These livestock feeders stop pollution."

⁸² Stewart W. Melvin to Dewey Bondurant, 5 August 1970, Hull Papers.

his lots would drain away from the river toward a retention pond. As Roy Olson explained, “We don’t want anyone pointing a finger at us for causing dirty water.” Similarly, Arnold Olson stated that “Clean water, clean air, and clean environment is really the thing right now. I would surely advise anyone building a new feedlot to consider runoff controls.” Costs for waste control measures ranged from approximately \$1 per head to \$6, depending local conditions and the size of herd. Many farmers were willing to pay these costs, especially with assistance through the REAP program. Farmers recognized that they were under scrutiny from outsiders and neighbors and wanted to avoid real and perceived pollution problems.⁸³

Farmers committed to highly automated and large scale operations who were subject to the new environmental regulations were the minority in 1972, but the new techniques were important to a growing number of farmers. Farmers who used push button techniques produced a growing portion of Iowa’s farm output. Farm families could produce more milk and meat than ever before. Large-scale dairy and livestock production was a reality made possible by the combination of automated materials handling and new drugs. Farmers who used these new systems were leaders in changing the rural landscape. *Wallaces Farmer* recognized the ways in which farmers altered production strategies by sponsoring the annual “Master Farmer” program to honor farmers for excellence in farm management and community service. Each year the magazine solicited nominations from people across the state. A panel consisting of representatives of the Master Farmer Club, an editor from the

⁸³ Bob Dunaway, “What cost to stop feedlot pollution,” *Wallaces Farmer*, 27 February 1971; “These livestock feeders stop pollution.”

magazine, and an Iowa State University Farm Management Specialist selected several farmers among each year's nominees to receive the honor.

The men who received the Master Farmer honor were all large-scale producers who used the latest technology. Every one of the five recipients in 1970 practiced some kind of automated materials handling technique, from bulk tanks to outdoor auger feeding to confinement feeding for hogs. One farmer piped water into feed boxes in his milking parlor to wet the feed to aid as an aid to digestion. Another farmer used a bulk feed delivery service for his hog finishing confinement. Not surprisingly, one of the five men even designed his own system, incorporating an old coal stoker from a furnace to add supplements to his feed. The commitment to innovation through labor saving devices and expansion was part of Iowa's remade agricultural landscape. Larger operations, more intensive livestock production, serious environmental consequences and government regulation relating to waste management on these new-style farms were the legacies of this generation of farmers.⁸⁴

⁸⁴ "1970 Iowa Master Farmers," *Wallaces Farmer*, 24 January 1970.

CHAPTER SIX

Making Hay the Modern Way

After World War II Iowa farmers reorganized their work by using new kinds of haymaking equipment. The old method of putting up loose hay in the barn was physically demanding, time consuming, and labor intensive. With the introduction of new machinery that automatically baled hay or chopped it into small pieces, farmers had to make choices about the ways in which they would deal with one of the most important crops in their crop rotation systems and production. Farmers could continue to use the tools that they, their parents, and grandparents used or they could try something new. While a handful of farmers continued the old techniques, most of them used new technology for the hay crop. They did so, however, in different ways. All farmers cared about costs of production, labor scarcity, and the quality of the crop, but the tools they used reflected different goals. Some farm families used forage choppers and hay balers to help them expand their farms or specialize in an effort to beat the postwar cost-price squeeze in which the prices they received for their products did not keep pace with their expenses. For other farm families, using a hay baler was a means of continuing to farm with a diverse mix of crops and livestock, frequently using labor exchanges to minimize expenses. New technology helped farmers with diverse goals meet their needs.

In the years up to 1945, most farmers cut and raked their grass or legume forage crop with mowing machines and rakes, picked it up from the field with a hay loader, and hauled it to the barn where they used a hay fork to put it in the barn loose, just as it came from the field. This system was laborious, requiring three or four laborers who handled the crop at least three times to get it into the barn; once from the windrow to the hayrack, once from the

hayrack to the barn, and once in the barn to spread the new hay across the mow. Some farmers baled hay or straw using a stationary bale press or one of the newer pick-up balers that could be pulled through the field, but both of these machines required a tractor driver and two operators to tie the bales using lengths of wire. The most common use of the baler was to bale straw after threshing for use as animal bedding. Baling hay was advantageous for farmers who wanted to sell or move hay during the winter months, since it was easier to handle and stack for the second time without losing nutrient rich leaves. But for most farmers, baling hay did not pay.¹

Haymaking changed very quickly after the development of the self-tie baler and forage harvester. In the late 1930s, a man from New Holland, Pennsylvania developed an automatic twine-tie baler, which the New Holland Machine Company produced in large numbers beginning in 1940. In 1944 the International Harvester Company, based in Chicago, produced its first version of the automatic twine baler. Field forage harvesters, also known as forage choppers, were also new in the 1940s. These machines cut and chopped the hay into small pieces in the field and blew the cut forage into a truck or wagon pulled behind the harvester. Farmers then hauled the crop and fed it to livestock or stored it in a barn, shed, or silo. While engineers developed these machines in the 1930s, very few of them actually saw use in fields during the depression years or during World War II when the federal government focused on producing war materiel and restricted domestic industrial production.

¹ Albert P. Brodell and Martin R. Cooper estimated that in 1944 approximately 75 percent of hay stored on farms in the United States was loose, long hay. "The Costs and Ways of Making Hay," in *Grass: The Yearbook of Agriculture, 1948* (Washington, D. C.: U.S. Government Printing Office, 1948), 173. James A. Young's study of haying in the western United States is an excellent recap of different haying techniques in the period up to World War II. See "Haymaking: The Mechanical Revolution on the Western Range," *Western Historical Quarterly* 14 (July 1983): 311-326.

At the end of the war, however, there were two new options to consider when making decisions about handling hay.²

In the late 1940s Iowa farmers began a rapid switch to new haying techniques, especially baling. In an effort to do more work, more rapidly, and with less strenuous effort, farmers began “Making Hay the Modern Way,” as one journalist noted in 1946. Some farmers who used the older techniques of the hayloader or the two-man, hand tie baler complained that these methods involved too much work, especially when they were aware of the labor savings of the automatic, twine tie baler and the chopper. They considered investing money in more expensive implements to reduce physical exertion. By the time the of the 1951 haying season, 41 percent of Iowa farmers planned to bale all or part of their crop, while only 14 percent of farmers planned to handle almost their entire crop as loose hay. The rest of Iowa farmers surveyed were somewhere in the middle, with plans to bale varying proportions of their crop. Only 17 percent of farmers planned to field chop their hay. The next year’s survey showed that baling was the most popular way to handle the hay crop in 1952, with 55 percent of farmers planning to bale their entire hay crop. The commitment to chopping remained approximately the same that year.³

Farmers made this rapid turn towards new haymaking techniques as they confronted the looming postwar labor shortage. Many people and hired hands left rural communities during the war for military service or work in defense industries. As the war effort surged in 1944, a writer for *Wallaces’ Farmer* observed that farmers were desperate for hired help, but

² W. R. Humphries and R. B. Gray, “Partial History of Haying Equipment,” United States Department of Agriculture, *Information Series No. 74* (Washington, D.C.: U.S. Government Printing Office, Revised October 1949), 55-6; O. F. Scholl, “The Twine Baler,” *Agricultural Engineering*, November 1947, 501.

³ “Making Hay the Modern Way,” *Wallaces Farmer*, 6 July 1946; Richard George Schmitt, jr., “Economic Analysis of Haying Methods in Eastern Iowa” (M.S. thesis, Iowa State College, 1947), 52-54; “How To Handle Your Hay,” *Wallaces Farmer*, 2 June 1951; “Half Of Farmers Bale All Hay,” *Wallaces Farmer*, 19 July 1952.

asserted that Iowa farmers were confident that they would soon have more labor saving machinery available to help them do what they had done with human labor before the war. But even though the new machines were available for purchase or hire after the war, farmers continued to struggle with the labor shortage for years. One farmer from Wright County testified that one of his sons entered the army during the Korean War and that he would have to hire more custom work. He anticipated that he would “sell the hay in the field and let somebody else put it up.” Farm families continued to deal with fewer hired men, smaller family size, and a contraction in the number of farm operations for the next twenty-five years.⁴

Manufacturers and advertisers appealed to farmers’ anxieties about the labor shortage as well as their optimism about technological solutions. An advertisement for John Deere haying equipment from 1958 focused on labor savings by invoking concepts of modernity, cost reductions, and freedom. Farmers could “Make Hay THE ONE MAN WAY” by using the “Revolutionary” new Deere haying system. A “one man crew” could use a combination mower and conditioner to get the crop on the ground, rake it, bale it and load the wagon with an automatic bale ejector, the center piece of the advertisement. The bale ejector pitched the newly made bale into the wagon hitched to the rear of the baler, replacing one or two people who would have been needed to stack the bales on a hayrack. The other revolutionary element of the system was the automated storage component. A conveyor would move the bales up into the barn and along the ridge of the barn before dumping them into the mow. Automating the work of hay storage would replace one or two workers who would have been

⁴ “That Hired Man,” *Wallaces Farmer*, 15 January 1944; Marcus and Segal, *Technology in America*, 301; J. B. Davidson and D. K. Struthers, “Haying with Less Help,” *Farm Science Reporter*, 4 (April 1943), 3-6; “How to Handle Your Hay.”

needed to stack the bales in the barn, which was a hot, dirty, and physically demanding job. This revolution would enable farmers to not only profit, but to “find new freedom,” an alluring claim in a time of Cold War tensions and labor shortages.⁵

While baling saved labor, chopping hay was even less labor intensive. A University of Minnesota study indicated that farmers spent approximately 2.2 hours to put up one ton of hay using the old hay loader method, 1.7 hours with a self-tying baler, and 1.2 hours with a field chopper. A married couple from Jones County proved that a husband and wife team could make eighty acres of chopped hay by themselves without hired help. The Anderson family was firmly committed to livestock raising. Only seventeen acres of their 240 acre farm were planted in corn while eighty acres was in a mix of alfalfa and brome hay that they used to feed beef cattle. The Andersons used a mower with a crusher attached to cut and crimp the stems to speed drying. Then, Mrs. Anderson operated the chopper while her husband hauled the hay to the barn and unloaded it. The Andersons handled eighty acres by themselves by substituting machinery for a crew of three or more workers. Furthermore, they spared themselves a great deal of demanding physical work. With automatic unloading wagons, they conducted all the work from the tractor seat.⁶

A rapid hay harvest was important because it coincided with the labor-intensive work of cultivating the corn crop, adding more incentive for farmers to choose baling or chopping. While farmers who used newly developed growth regulator herbicides such as 2,4-D could expect to reduce the amount of time they spent controlling weeds in their cornfields, only a few farmers gave up cultivating altogether. Most continued to face the difficult decision of

⁵ John Deere Advertisement, *Wallaces Farmer*, 15 February 1958.

⁶ “Workday Pointers,” *Wallaces Farmer*, 20 June 1953; “Two Can Make Hay,” *Wallaces Farmer*, 4 September 1948.

choosing between cultivating and haymaking. Almost half of farmers surveyed in 1957 agreed with the statement that they cut hay when it fit in best with other work. An Ida County farmer stated, “Hay making has to wait on corn cultivating on our farm. Corn is the important crop.” If farmers could find a way to speed haymaking, they could lessen the pressure to choose between two or more important tasks.⁷

Hay crushers or hay conditioners were valuable tools in speeding the harvest. A conditioner was an implement that consisted of a set of rollers, either smooth or fluted, mounted on a frame that could either be pulled on its own or behind a mowing machine. The hay moved between the rollers that squeezed or crimped the stems and leaves of the crop. Hay that had been through a conditioner dried faster, since the moisture from the thick stems evaporated faster. A Marshall County cattle feeder with ninety acres of hay followed behind his mower with a conditioner in the 1959 season, claiming that crushed hay dried in half the time as it normally would in a windrow. “Last year was the first we’d ever tried a hay crusher,” reported Earl Felt, a dairy farmer from Dallas County. “It eliminated at least one day’s drying time.” Hay conditioners became especially popular in Northeast Iowa where commercial dairying was more widespread.⁸

Farmers who stored hay that was too moist found that their crop became moldy and was unpalatable to livestock. Furthermore, hay that was stored when it was too wet could spontaneously combust. The microbes that break down the carbohydrates in the plant material are killed off by the heat generated by tightly packed moist hay. Once the microbes

⁷ “Cultivate corn or make hay?,” *Wallaces Farmer*, 4 June 1955; “Can you guess the weather?,” *Wallaces Farmer*, 20 July 1957.

⁸ Kenneth K. Barnes and Robert C. Fincham, “Yes, Hay Crushers Can Cut Field Risks,” *Iowa Farm Science*, 12 (May 1958); Dick Seim, “Early-cut hay is best,” *Wallaces Farmer*, 16 May 1959; “Conditioned hay dries faster,” *Wallaces Farmer*, 21 May 1960; “For faster haying and better hay,” *Wallaces Farmer*, 23 May 1970.

are dead, a chemical reaction occurs in the hay which generates flammable gasses that ignite when they contact oxygen. As long as farmers stored loose hay they could put it in the barn with moisture content from 25 to 28 percent. However, baled hay is more compact, with less chance for it to dry. Baled hay could be stored safely with a moisture content of no more than 25 percent. Hay conditioners were important implements for farmers who baled, since they allowed a faster harvest and one that minimized the risk of using new baling technology.⁹

Even though speed and labor savings were important considerations, farmers also needed to consider quality. Baling offered labor savings, but farmers who chopped hay or made haylage (a fermented product like silage) reportedly made better quality feed. By the 1950s, there were reports that chopped hay and silage retained more vitamin A and protein than baled hay. Iowa State College and experiment station tests indicated that as much as 15 percent more protein and from 10 to 20 percent more of vitamin A could be retained in the plant material with silage when compared to baled hay.¹⁰

Making forage with the chopper also minimized the risk of getting rain on the cut and cured crop before it could be put in barn. Rain on cured hay caused it to break down and leach the nutrients out of the plant material. Farmers guessed what the weather would do; always hoping that they could make hay in sunny weather. One farmer who baled his hay reported that he baled on the second day after he mowed hay, making it a three day cycle to make the crop. Experts estimated that it took approximately thirty hours of sunshine to cure

⁹ *Midwest Farm Handbook, Fifth Edition* (Ames: Iowa State University Press, 1960), 613.

¹⁰ "Forage harvesting aimed at quality," *Wallaces Farmer*, 2 May 1959.

hay, but the odds of getting rained on during that period were one in three. Farmers who chopped hay could store it much more quickly and avoid a damaged crop.¹¹

It was also easier to control what cattle ate with chopped hay. When feeding loose hay, animals could select the leaves, generally the most attractive parts of the plant, and leave the tougher stems behind. William Pfab of Dubuque County testified that cattle wasted less of their feed with chopped hay. “The cows have to eat the tough stems right along with the leaves,” he reported, “They can’t sort out parts they like best.” This was even less of a problem with silage. A farmer from Cedar County stated that he made grass silage out of his first cutting of hay. “Ensiling makes the stems more tender and palatable,” he contended.¹²

Manufacturers and advertisers emphasized the flexibility farmers could gain by using new haymaking machines. The Allis-Chalmers Company developed the Roto-Baler in the 1930s and first marketed it in 1947, claiming that the small round bales made higher quality bales than competing models. The round bales preserved more protein because the leaves and stems were rolled together rather than packed. In addition, the round, tightly wound bales shed water much better than square bales, which meant that they could be left in the field after the third cutting. Farmers could turn their cattle out over the winter to consume the bales in the field, a practice that Doyce Miller and his son Lyle used in Clarke County in the early 1960s. Depending on the size of farm, this saved handling hundreds or thousands

¹¹ “Take Sweat and Risk From Hay-Making,” *Wallaces Farmer*, 7 August 1948; Wendell Clampitt, “Save Sweat, Dust In Haymaking,” *Wallaces Farmer*, 17 June 1950; Jim Rutter, “Grass silage or hay?,” *Wallaces Farmer*, 3 May 1958.

¹² Jim Rutter, “Will you bale or chop?,” *Wallaces Farmer*, 7 June 1958; Rutter, “Grass silage or hay?.”

of bales. These bales were also somewhat difficult for cattle to open, which meant that the animals would completely consume one before opening another, reducing waste.¹³

Regardless of whether farmers chose to cut operating costs by using balers or choppers, they faced increased capital expenses for the new equipment. During the late 1940s the lowest cost new equipment on the market was equipment for making loose hay, which included a hayloader and fork that farmers could purchase for \$543 in 1946. Estimates for the new one-man field baler, which automatically tied the bale with twine, cost \$2,365 while a forage harvester cost \$3,486 that year. For the money invested in a baler, a farmer could expect to spend about half the time in getting hay to the barn. The chopper saved an estimated five-eighths of the labor when compared to making loose hay. The cost of new balers and choppers remained high through the 1950s, with farmers spending between \$3,000 and \$4,000 for a chopper, depending on the size, and as much as \$3,500 for a baler, although William Adams of Fayette County purchased a new McCormick-Deering Number 45 baler at the beginning of the 1952 haying season for \$1,571.¹⁴

The issue of farm finances in re-mechanizing the hay harvest demonstrated important distinctions between farmers. Farmers who either kept large acreages or those who were interested in specializing or expanding liked the forage harvester, since it moved rapidly through the crop and eliminated human handling, a savings in terms of labor and sweat. The baler saved money over the older technology and it was cheaper than the chopper. Farmers who did not want to make the investment in the machinery cost had to find alternative ways

¹³ Doyle Brubaker, interview by author, 7 September 2001, Newton, Iowa, tape recording; Allis Chalmers Roto-Baler advertisement, *Wallaces Farmer*, 2 April 1955; "Stacking trims haying costs," *Wallaces' Farmer*, 2 June 1962; "Which haying method for beef cattle?," *Wallaces Farmer*, 2 June 1962.

¹⁴ "New Hay Machines Save Labor," *Wallaces Farmer*, 16 August 1949; "What cost for making hay?," *Wallaces Farmer*, 6 June 1955; Adams papers.

of making the transition to the new technology, which included purchasing used machines, and more importantly, participating in labor exchanges and making joint purchases of machines.

Exchanging labor on the farm was a popular method of accomplishing work while minimizing costs. Historians have documented the importance of labor exchanges in rural America, but in the case of haying, labor exchanges gained favor as hired men became scarce. In the prewar period, some farmers cooperated to make hay, but the results were mixed. Some farmers who exchanged labor were not prepared and consequently started late or had inferior or dilapidated equipment, while others were ready to go and maintained their machines. Farmers also had to deal with differences in acreages; one family's farm might have twenty acres of hay while another had fifty. In these instances, farmers had to reconcile the difference. These inequalities made changing work problematic, but it was successful for many farmers who shared a similar work ethic, managed their farms the same way, or had strong kinship ties. As farmers looked into the postwar world and anticipated continual labor shortages, some of them realized that they might have to do more work exchanges. As one farmer stated with a bit of hyperbole, "I guess we neighbors will have to get acquainted with each other and learn to work together."¹⁵

Work exchanges were especially popular with farmers who had smaller acreages and practiced mixed farming rather than specializing in dairy production or beef cattle. Two brothers from Marshall County joined several neighbors to form a baling ring and hired a

¹⁵ J. Sanford Rikoon demonstrated how new threshing machines actually complemented and even strengthened work exchange patterns in the nineteenth century Midwest. Mary Neth depicted the importance of work exchanges for minimizing cash expenses in the years up to 1940. See Rikoon, *Threshing in the Midwest: A Study of Traditional Culture and Technological Change, 1820-1940* (Bloomington: Indiana University Press, 1988) and Neth, *Preserving the Family Farm*. "Make Hay Together," *Wallaces Farmer*, 16 June 1945.

custom baler to do the job for them. In addition to avoiding the outlay for the machine, these farmers claimed that they saved time by sharing the workload and improved the quality of the hay they harvested. Younger farmers who were just getting started liked the labor exchanges and were more likely to exchange work than established, middle-aged farmers who owned more machinery.¹⁶

Exchanging work during hay harvest also let farmers use family labor effectively. After the war, a higher percentage of Iowa farm youths attended high school, a factor that exacerbated farmers' labor problems during the school year, but it also meant that children were still available to help cultivate corn and make hay during the summer. Around 1954 Charles Havran's oldest son joined the military, leaving a son who was in the eighth grade at home to help on the farm. When a neighbor purchased a used baler, his son and nephew joined with the Havran family to cooperate with hay baling. They set the baler to make small, light bales that were easy for the boys to handle. In the late 1950s, after the Havran family purchased their own New Holland baler, a pair of brothers from the neighborhood drove up to the Havran farm and suggested making hay cooperatively. Both families owned balers, so they would mow and bale at the same place at the same time to speed the work and get the hay in quickly to prevent rain damage. These families utilized teenage sons instead of hiring labor.¹⁷

Some farmers took the practice of work exchange one step further and cooperatively purchased a baler or chopper. This spread out the initial investment in the machine and allowed them to share operating costs. Farmers accepted the need for cooperative

¹⁶ "What's Best Way To Get Quality Hay?," *Wallaces Farmer*, 7 June 1947; "Exchanging work with neighbors," *Wallaces Farmer*, 6 July 1957.

¹⁷ Dennis Havran interview.

purchasing, especially for father-son ownership agreements. Cooperative ownership among non-family members was potentially more risky, but many farmers had successful partnerships. George Lee of Hardin County liked his arrangement with Floyd Lake and Emery Lake. They lived about two miles from each other and invested in a chopper. When they traded in a chopper for a newer model in 1952, each farmer only had to contribute \$505. Cooperative ownership was advantageous for another reason. “What’s nice about this arrangement,” Lee noted, “is that you get your work done when you want it done,” rather than waiting to fit into a custom chopper’s schedule. In 1954 Melvin Hansen of Boone County purchased a baler with a second cousin without investing any money up front. When his relative suggested they purchase a baler together, Hansen replied that he did not have any money. His cousin bought the baler and Hansen paid off his share over the next couple of years. In 1956 31 percent of Iowa farmers owned hay balers with someone else, while only 6 percent jointly owned choppers. Farm owners were more likely to have cooperative arrangements than renters, given that farm leases were for one year and tenants did not necessarily stay in the same neighborhood from year to year.¹⁸

Hiring custom balers was a good strategy for farmers with smaller acreages. Balers were expensive, and there were only so many days that they could be used, including two or three cuttings of hay in the summer, baling some straw for livestock bedding after combining, and, in a few instances, baling corn stalks. An Iowa State College study from the late 1940s of the costs of baling in Eastern Iowa indicated that farmers needed to make at least ninety-three tons of hay per year to make owning a baler pay. Carl and Bertha

¹⁸ Schmitt, “Economic Analysis of Haying Methods in Eastern Iowa,” 56; Melvin Hansen, interview by author, 9 June 2003, Madrid, Iowa, tape recording; “Own machines in partnership,” *Wallaces Farmer*, 1 May 1954.

Petersen's farm account books show the premium they placed on custom baling as well as purchasing baled hay for their 113 acre farm. They hired balers for straw baling and hay on a regular basis in the 1950s and 1960s. By the late 1950s, the pattern of ownership versus hiring balers was clear. Only 36 percent of farmers who farmed between thirty and 179 acres owned their own machine, while the rest hired custom balers. By contrast, almost half of farmers who owned over 180 acres owned balers. For most farmers with smaller acreages, it made the most sense to hire a custom baler.¹⁹

Older farmers who were making the transition to retirement by reducing the amount of land they farmed or their workload also liked the idea of custom baling. They could eliminate the heavy work of moving hundreds of bales that weighed between forty and 100 pounds, depending on the farmer's preference. A 1957 survey of farmers indicated that farmers over the age of fifty exchanged work less often than younger farmers and also hired more custom work. This was true for the Petersons, since they began farming in 1931 and were at least in their fifties by the decade of the 1960s.²⁰

In contrast to the farmers who used field choppers alone or in combination with hay balers to increase production or to specialize, farmers who only used balers were more conservative in terms of farm strategies. They were less willing or able to expand production or to assume the increased capitalization to expand or to take the risks of specializing. For these people with limited goals, baling offered them ease of handling in combination with flexibility. This was especially true for farmers who hired custom balers. A farmer from

¹⁹ Schmitt, "Economic Analysis of Haying Methods in Eastern Iowa," 48; "Can you guess the weather?," *Wallaces Farmer*, 20 July 1957; Peterson papers.

²⁰ "Exchanging work with neighbors," *Wallaces Farmer*, 6 July 1957; Peterson papers.

Pocahontas County favored custom baling, since he did not have enough hay acres and livestock to justify owning a baler or a chopper.²¹

Even though hiring custom balers made sense for many people, others found that purchasing a baler and doing custom work for others could be a source of income. Custom rate charts were a regular feature of *Wallaces' Farmer*, noting average per bale charges, cost estimates on a per acre basis, as well as rates for almost every other farm task from planting to harvesting. It is likely that many of the farmers who owned balers and farmed small acreages hired themselves out as custom balers in order to make owning a baler pay. Farm families such as the Petersons provided a ready market for those who were willing to invest from \$1,000 to \$1,500 in a baler. A Tama County man reported that the increase in the number of balers was good news for those who wanted to hire balers. "Lots of balers in the country," he stated in 1951, "Maybe I can get it done cheaper this year." Custom rates for baling fell by as much as 20 percent from the late 1940s to the early 50s for the Petersons. They paid \$.12 per bale in 1948, \$.11 in 1949, and from 1954 to 1967 paid \$.10 per bale. When Vernan Schnack, a twenty-two year-old renter from Shelby County, began farming on his own in 1959, he purchased a new baler for \$1,500 to use on his rented farm and to hire out for custom work. "I figured I'd be paying out in custom charges (\$150 for 3,000 bales) just as much as depreciation on the new machine would be," he explained. "Also, now I can bale when I want to and pick up some money doing custom work." For Schnack, buying a

²¹ Jim Rutter, "Will you chop or bale?," *Wallaces Farmer*, 7 June 1958.

baler was a means of gaining independence in his farm operation as well as a method of increasing his income.²²

The labor savings of chopping grass made it especially useful for farmers who either wanted to expand their acreage or specialize in dairying or beef cattle feeding.

The added expense of the chopper and wagon or wagons made it critical for dairy farm families who wanted to green chop their forage to have at least twenty-five milk cows to justify the cost. When discussing whether to make hay or grass silage, farm journalists noted that grass silage yielded about 10 percent more feed per acre then compared to grass hay, a figure that widened considerably when rain fell on the cured hay. If farmers were in a position to utilize the extra feed value of the silage by increasing their feeding operations, then silage made economic sense.²³

In the early 1950s farmers began to use choppers and wagons to haul forage directly to their cattle in lots, bypassing the need to store as much forage and reducing the pressure on pastures. This new system, called green chop or zero grazing, was a method of using the forage harvester and special wagons to chop hay and move it directly to feed bunks. By keeping cattle in the feedlot, farmers avoided the traditional pasturage problems of trampling and selective grazing by cattle that chose the most succulent plants and left the rest. With a

²² "How Much To Hire A Combine?," *Wallaces Farmer*, 19 June 1948; "How To Handle Your Hay," *Wallaces Farmer*, 2 June 1951; Peterson papers; Richard Hagen, "How much money for machinery?," *Wallaces Farmer*, 2 June 1962.

²³ "Forage harvesting aimed at quality," *Wallaces Farmer*, 2 May 1959; Al Bull, "Make Hay or Silage?," *Wallaces Farmer*, 15 May 1954.

green-chop system, there would be no trampling of pasture and all the feed was mixed together, preventing selective grazing.²⁴

Most importantly, green chopping was a means of increasing the size of beef and dairy herds. Gail Hemmingson of Plymouth County experimented with the system in 1954 and found that he cut his acreage requirements for feeding his herd. In 1953 he needed thirty acres of pasture for fifteen cows with calves. In 1954 he kept fifteen cows with calves plus ten heifers by green-chopping nine acres. John Dane of Johnson County cut the acres he needed to keep his thirty-five dairy cows which allowed him to go through the winter without buying feed. The experiences of a farmer from Woodbury County who rejected zero grazing indicate just how important the practice was to farm expansion and specialization. He acknowledged that it allowed him to double his carrying capacity, but he claimed that his small herd did not justify the labor cost of feeding in the lot. He concluded that farmers with bigger herds were in the best position to profit from zero grazing. Even though it appeared that cutting acreage requirements for feeding could appeal to farmers with smaller acreages who wanted to increase their herd size, the high cost of the forage made it more economical for farmers with larger acreages who could spread the investment and operating costs over more acres and larger herds.²⁵

Green chop feeding allowed significant gains in productivity per farmer and per animal. Robert Liston, a Dallas County dairy farmer, began using a green-chop system in 1957, claiming in 1961 that his forty-five dairy cows had not been on pasture in five years. According to Liston, "I find it easier and cheaper to haul feed to them." Liston began

²⁴ "Want to stretch you pasture?," *Wallaces Farmer*, 5 June 1954; Dave Bryant, "Stretch pasture with "zero" grazing?," *Wallaces Farmer*, 7 May 1955; Vernon Schneider, "Green-lot feeding," *Successful Farming*, March 1955.

²⁵ Bryant, "Stretch pasture with "zero grazing"; "Carry pasture to your cattle," *Wallaces Farmer*, 6 May 1956.

chopping in May and continued into October, cutting two loads for the morning feeding and one for the evening, totaling about an hour per day for one operator. Although farmers who used the green-chop system boosted their production with minimal work, they did have new work to do as a result of their commitment to dry lot feeding. Liston reported that his biggest problem was manure removal. With the cattle in a lot rather than on a pasture, Liston had to move tons of manure out of his lots to prevent them from becoming a quagmire. In 1960 he hauled approximately 190 loads of manure out of the cattle shed and another 100 loads from the feeding area, which meant that he moved manure an average of eight days out of every ten.²⁶

In spite of creating new work, dairy producers like Liston were especially interested in forage harvesters and green chop. In the years after World War II, most Iowa farmers abandoned dairy production, getting rid of their small herds of approximately half a dozen animals that provided income through a regular cream check. A minority of farmers invested new money in dairying to cut operating costs and improve quality. The forage harvester and related equipment, including hay driers, played a key role in allowing them to stay competitive in the late 1950s. Farmers found that cheaper forage crops could be substituted for some expensive grain in the dairy ration. In dairy farming, one of the key calculations is the difference between gross income from milk production and the cost of feed. The resulting figure, called income above feed cost, is a test of whether or not a dairy farm can stay in business. As one Fayette County farmer put it, "You have to feed for top production. Yet you have to hold feed costs down if you expect to stay in dairying." He cut costs by replacing grain with silage. Other dairymen echoed this conclusion. Two farmers from

²⁶ Dick Hagen, "Drylot dairying," 20 May 1961.

Northeast Iowa discussed their costs and production with a reporter from *Wallaces' Farmer*. While their cows averaged from 12,000 to 14,000 pounds of milk per year per cow, their income above feed cost was good, in spite of the variance in production. The cows that yielded 12,500 pounds per year had an income above feed cost of \$322 per cow, just two dollars less than the cows producing 14,000 pounds. Both farmers used almost twice as much hay and silage as they did grain or concentrated feeds, minimizing their commitment to higher grain costs and purchased feed.²⁷

Every farmer who decided to re-mechanize the hay harvest by baling or chopping their crop faced new storage problems. The large barns on most Iowa farms were built for storing loose hay, which was bulkier and required more space per ton than the dense, compressed bales or the chopped hay which packed in the mow tightly and also took up less space per ton. Iowa State College experts advised farmers that baled hay weighed three to four times more per cubic foot than loose hay, while chopped hay was twice as heavy as loose hay. Farmers who had overhead or second storey mows in their barns needed to reinforce their mows to prevent structural damage to their largest and most expensive building.²⁸

Handling the crop in the barn was also a major problem. Some farmers installed bale conveyors in their barns to reduce the heavy workload of handling bales, like the one described in the earlier John Deere advertisement for revolutionary hay making. Elwood and James Walker of Polk County installed a bale conveyor to get around the labor shortage. While the bales simply tumbled off the conveyor into a pile in the mow, the Walkers were

²⁷ Ray Franklin, "Cheaper milk from forage," *Wallaces Farmer*, 21 September 1957.

²⁸ "Old Barns," *Wallaces Farmer*, 21 July 1951.

not concerned about the lack of a tightly packed stack. They believed that air circulation was better with the loose pile of bales than with a stack, which cut the risk of spontaneous combustion from hay that may have been too wet. Any lost space was more than compensated by reducing the need for one or two men in the barn stacking bales.²⁹

Chopped hay posed special problems for farmers who chose to specialize or expand their operations. Some farmers modified their barns by adding hay driers. These dryers forced air through wire, sheet metal, or slatted wooden ducts in the haymow. Hay dryers accelerated the drying process and enabled them to store larger amounts of chopped hay. In 1950 Kenneth Parrett, a farmer who kept a herd of forty-five Holstein cattle on 210 acres in Washington County, began using a dryer in his barn. He believed that by bringing hay into the barn with higher moisture content he would avoid losing the leaves. Farmers who field-cured their hay handled it more and risked losing as much as 15 percent of the total volume of the crop through knocking off dried leaves. By keeping more leaves on the hay farmers could get more feed for the labor and fuel cost they invested in cutting it, picking it up, and hauling it to the barn.³⁰

Using a hay dryer not only helped improve the amount of hay farmers could harvest, but it also improved the quality of the crop. Kenneth Parrett observed, “barn-cured hay has better color. It’s more palatable,” which meant that the animals consumed more of it. Eldred Mather, a Floyd County dairy farmer, related his success with a dryer. “The thing I noticed

²⁹ Jim Rutter, “Will you chop or bale?,” *Wallaces Farmer*, 7 June 1953; “Easy ways to move hay,” *Wallaces Farmer*, 21 June 1958. A study by an Iowa State College graduate student concluded that it was not worth the time to stack bales in the barn. It was more efficient to let the bales fall into the barn, especially since 3.4 percent of the dropped bales broke upon contact with the bale pile, making it difficult and time consuming to stack. In short, stacking bales in the barn offset labor savings in the field. Gerald L. Kline, “Harvesting Hay With The Automatic Field Baler” (M.S. Thesis, Iowa State College, 1946), 78.

³⁰ R. B. Gray, “Equipment for Making Hay,” in *Grass: The Yearbook of Agriculture, 1948*, 169; Dave Bryant, “Do you need a Hay Dryer?,” *Wallaces Farmer*, 7 June 1952.

when I started [in 1955] feeding high quality alfalfa that was mow-dried was that it took less protein supplement in the ration to give the same results in butterfat production.” Having a hay drier meant that farmers could cut hay at the proper stage of the growth cycle for optimum nutrition. Promoters of barn-drying were careful to point out that it was costly, which meant that only farmers who had large numbers of livestock should consider making the investment. As a result, hay dryers remained equipment for the minority of farmers who stored chopped hay in their mows.³¹

Although filling barns with bales or chopped hay was the most common method of storing hay, farmers turned to other ways to deal with hay storage. Using and adapting the old barn might have been less expensive (unless it included a hay dryer) but it required a lot of handling to get the crop out of the barn to the livestock. Adaptive reuse of the barn for baled hay or forage saved labor at harvest time, but it did not help at feeding time, which was a daily chore. If farmers were to realize fully the labor savings they craved, they needed to either automate their feeding operations (see chapter five) or consider new structures for storing the crop that would give them ease of feeding.

The haykeeper, a cylindrical or rectangular pole building, was one solution that some farmers turned to in the late 1950s and 1960s. Iowa State College experts designed the haykeeper to be a self-feeder for chopped hay. The building was wider at the bottom than at the top to reduce friction and let gravity move the hay downward as cattle consumed it. A large cone at the center of the bottom forced the hay to the outside of the bottom into mangers for feeding. This feature made the structure attractive to farmers who wanted to

³¹ Dave Bryant, “Do you need a Hay Dryer?”; Keith Remy, “How to get the most from your hay,” *Wallaces Farmer*, 21 May 1960; Dick Seim, “Early-cut hay is best,” *Wallaces Farmer*, 16 May 1959.

expand their herds while simultaneously cutting labor costs. “The self-feeding feature is what sells me on haykeepers,” noted a dairy farmer from Northeast Iowa. Leon Wengert of Story County constructed a rectangular haykeeper for beef and dairy cattle. This structure, fifty feet long, twelve feet wide, and twenty feet high, housed his first cutting of hay, since it could be stored in the haykeeper with less risk of spontaneous combustion than in a barn. It also helped cut labor costs at chore time. Extension agents offered plans for plans for fifty and sixty ton models, which could be built for approximately \$800 to \$1,100, depending on size as well as local costs for materials and labor. These haykeepers could also be built with central ventilator shafts that could be equipped with a large fan and motor to speed drying of the hay. This feature increased the costs of the building, but reduced the amount of time the crop needed to dry in the field, since more drying occurred in storage.³²

Upright silos were a costly solution to the problem of making high quality feed. The high first cost of upright silos generally meant that they were reserved for the corn silage crop rather than the hay crop. Farmers, researchers, and extension professionals found that corn silage had higher nutritive value than haylage, which meant it was better to use the high cost silo for highest quality feed. Some farmers began to use their silos for storing high-moisture corn that had been harvested by combines or picker-shellors that became popular in the 1950s rather than by the older corn pickers that harvested the entire ear instead of just the grain. With high moisture corn and silage in the silos, farmers who chopped searched for other places to store haylage.

³² Gene C. Shove, Kenneth K. Barnes, and Hobart Beresford, “A Self-Feeding Hay-Storage Structure,” *Iowa Farm Science*, 8 (June 1954); “Cut hay handling with haykeeper,” *Wallaces Farmer*, 15 August 1959; Glenn Cunningham, “They Gross \$50,000 on 240 Acres,” *Iowa Farm and Home Register*, 6 March 1955.

Farmers could cut haylage costs by making trench silos, a decades-old but still popular and low cost storage method of keeping corn silage. After leveling and scraping a strip of earth approximately twenty-four by seventy-five feet or large enough to accommodate the crop, they could build a fence along the edge and line it with Kraft paper to keep oxygen out and prevent spoilage. Then, they dumped the chopped hay onto the scraped earth, leveling and packing it as they piled it deeper and finally covering it. As farmers needed the feed, they could either use a tractor loader to haul silage to livestock or even use electric fence to let cattle eat directly from the silo.³³

Bale storage was easier and less expensive than storing haylage or chopped hay. Some farmers built low cost hay sheds to store bales, or even stored bales out in the open. One Greene county farmer built a thirty-one by fifty foot “umbrella shed” to store 3,200 bales. A line of five center posts supported the roof, with no side or end walls to impede stacking and loading. The owner, Paul Williams, stated “The quickest and easiest way of unloading and storing hay was what we were after.” Williams could simply pull up next to the stack without worrying about hitting walls or supporting members with his tractor or hay rack. Farmers who stored baled hay outside had the easiest work in unloading and stacking, but there was some loss through spoilage along the top of the stack. Some farmers accepted a small loss on an outdoor bale stack as a preferable alternative to investing in a new hayshed. As long as the farmer removed bales from the end of the stack rather than the top, he could minimize the inevitable loss associated with stack storage and still have good quality feed for livestock. As noted previously, the Allis-Chalmers Roto-Baler made bales

³³ “A Silo In A Hurry,” *Wallaces Farmer*, 15 July 1950; “Temporary silo for you?,” *Wallaces Farmer*, 4 September 1954.

that were well-suited to outdoor storage and self-feeding for beef cattle. Farmers who used these machines could further reduce the need to store hay. Regardless of how farmers solved their storage problems associated with the new haymaking machines, they did not envision a future characterized by the intense and time consuming work of putting up loose hay the way previous generations had done it.³⁴

The number of balers and choppers on Iowa farms reflected the interest and confidence Iowa farmers had in the new technology and their ability to adapt work routines, finances, and buildings to balers and choppers. In early 1962 there were 49,177 balers and 12,774 forage harvesters on Iowa farms, while in 1970 there were 48,052 balers and 15,159 forage harvesters. Although the number of balers declined by 1970, the proportion of balers to the number of farms was actually higher, which meant they were more common on Iowa farms. In 1961 there were 177,172 farms in Iowa, with a ratio of one baler for every 3.6 farms. In 1970 there were only 135,264 farms, with a ratio of one baler for every 2.8 farms. The increase in the number of forage harvesters was even more profound in comparison to the changing number of farms, with the 1961 ratio of one harvester to every 13.8 farms and the 1970 ratio one harvester to every 8.9 farms. Farmers decided to make hay “the modern way” because they could use machines to replace labor.³⁵

Balers were essential on all Iowa farms that included livestock in 1972. Not all farmers owned balers, but almost all farmers used them, choosing to hire or share one if they did not own one of their own. Farmers with small acreages frequently hired custom balers to

³⁴ “Builds low-cost shed for storing hay,” *Wallaces Farmer*, 21 July 1962.

³⁵ *Fifth Biennial Report of Iowa Book of Agriculture, 1960-1961*, (Des Moines: State of Iowa, 1962), 353; *Iowa Book of Agriculture, 1970-1971*, 368. While describing a very different place, historian Donald Holley depicted how southern farmers used mechanical cotton pickers to deal with postwar labor shortages. See chapters eight and nine of *The Second Great Emancipation*.

do their work, paying a flat fee per bale. Other farmers, large and small, decided to purchase a baler in cooperation with a friend, neighbor, or family member, minimizing their initial outlay and sharing operating costs. These farmers were less likely to enlarge their livestock operations or to specialize in beef or dairy animals. They kept a mix of animals and crops while they continued rural traditions of work exchanges. But even farmers who specialized valued hay balers. Compared to feeding strictly green-chop hay or haylage, it was cheaper to have some hay baled to maintain flexibility in their feeding programs.

Only a minority of Iowa farmers purchased forage harvesters, although they were essential machines on farms that were larger and more specialized. These machines were very expensive, although they could be used for harvesting hay and corn silage, thereby spreading their cost over more of the farm operation. Chopping hay, however, was quicker than baling, which meant that it was possible to harvest more forage and feed more livestock with a better quality feed. Using a forage harvester was an important strategy to beat the cost-price squeeze by offsetting declining commodity prices with more production and improved quality feed.

In 1967, farmers learned about a new baler that would allow producers to gain even more labor savings and literally increase the scale of production. The baler produced a giant, cylindrical hay bale of up to 700 pounds, with the potential of making one that weighed 1,000 pounds. Iowa State University engineers developed the machine with the goal of completely mechanizing hay handling. One operator with a tractor could handle these huge bales, transporting them to storage and taking them to livestock for feeding without touching the crop with human hands. By using the giant bales, farmers could avoid the strenuous and repetitive lifting farmers had grown accustomed to doing themselves or hiring others to do

for them. Wesley Buchele, a mechanical engineer at Iowa State University, summed up the purpose of the new machine. According to Buchele, “The giant bale is designed for mechanical handling, while conventional bales are designed for human handling.” It is difficult to know if farmers perceived this development as a sign of things to come or something so far-fetched and ridiculous that it would never be practical. If the postwar trends of substituting expensive machinery for scarce and expensive labor continued, however, farmers may have looked at the bale and glimpsed a future of completely mechanized hay handling.³⁶

³⁶ “Giant hay bale will mechanize handling,” *Wallaces Farmer*, 26 August 1967.

CHAPTER SEVEN

From Threshing Machine to Combine

“Sit-Down HARVEST
RIDE—AND WHISTLE WHILE YOU WORK;
FAMILY HARVEST INSTEAD OF THRESHING GANG

The man operating an All-Crop Harvester stopped near the fence to talk. “Look at my shirt,” he said, “it’s dry! I thresh sitting down.”

A dry shirt is only a symbol of the freedom and independence an All-Crop Harvester brings you and your family. DIRECT harvesting that frees you from the backaches of shocking...the dust and sweat of threshing...from big customs bills---and frees Mother from cooking for extra men.”

Allis-Chalmers All-Crop Harvester Advertisement, *Successful Farming*, March 1940

When this Allis-Chalmers advertisement appeared in the spring of 1940 combines were relatively scarce on Iowa farms. Few Iowa farmers threshed their grain without soaking their shirts with sweat. The practice of harvesting and threshing with separate tools and at different times was still the prevalent method of making a small grain crop such as oats. Farmers used tractor- and horse-drawn binders to harvest the grain, set up the bundles into shocks and, after letting the shocks dry in the field for a week or so, hauled the bundles to tractor-powered threshing machines in the barnyard. There, family members and neighbors gathered to feed the threshing machine, scoop the grain from wagons into the bins and granaries, and stack or bale the straw for use throughout the following year.

Between 1940 and 1970 most Iowa farmers turned to combines for harvesting their small grains and rejected the separate tasks of binding and threshing that had prevailed since the 1880s. When the implement industry developed a machine suited for the small farms of the Midwest, farmers began replacing the old tools with the new. The decision to use combines was based in part on the appeal of “sit-down” and “dry shirt” ease, but farmers

found more compelling reasons for abandoning their existing set of tools. Farmers in Iowa used combines during these years because they could afford to hire or purchase the machines, the technical obstacles were minimal, families enjoyed work and leisure benefits of increased mechanization, and the combine helped facilitate the transition from oats to soybeans that began in the mid-twentieth century.

Combines were not new inventions in 1940, but they were relatively new to the Corn Belt. Inventor Hiram Moore and financier John Hascall developed a workable combine by the 1850s, sparking a chain of developments that led to the general adoption of combines in the arid regions of the United States by the 1920s. These machines were tractor-drawn, powered by either an auxiliary engine or the tractors power-take-off, cutting a swath of eight feet or more through the massive fields of the Great Plains, California, and Washington. A handful of Iowa farmers used these combines on their farms, although they invariably performed custom work for other area farmers.¹

It was only in 1930 when inventors developed a prototype combine that farmers with the smaller acreages of the humid Midwest could afford to own. Both John Deere and McCormick-Deering produced tractor-drawn models that they planned to sell in the region, but these had ten and eight foot cuts, respectively, making them too large to be efficient for mixed farming. That year, *Farm Implement News*, a journal for dealers and manufacturers,

¹ Standard sources for the development of harvesting and combine technology include R. Douglas Hurt, *American Farm Tools From Hand Power to Steam Power* (Manhattan, KS: Sunflower University Press, 1986) and *Agricultural Technology in the Twentieth Century* (Manhattan, KS: Sunflower University Press, 1991); Graeme Quick and Wesley Buchele, *The Grain Harvesters* (St. Joseph, MI: American Society of Agricultural Engineers, 1978). Thomas D. Isern detailed the rise and eventual dominance of combines on the Great Plains in *Bullthreshers and Bindlestiffs: Harvesting and Threshing on the Great Plains* (Lawrence: University Press of Kansas); J. Sanford Rikoon discusses the beginnings of combined harvesting-threshing in *Threshing in the Midwest, 1820-1940*. A model study for Iowa farm mechanization in the twentieth century is Thomas Burnell Colbert, "Iowa Farmers and Mechanical Corn Pickers, 1900-1952," *Agricultural History* 74 (Spring 2000): 530-544.

printed three stories about a “baby” combine with potential application for farms of the Midwest. This machine, pulled behind a tractor, had a five-foot swath which made the machine practical for a region where 160 acre farms were the average. The threshing cylinder was also five feet long, maximizing operating speed. In addition to threshing almost any crop with a cylinder of wire brushes, the machine had low horsepower requirements, making it suitable for farmers with older or smaller tractors. Allis-Chalmers purchased the license to develop and manufacture the Fleming-Hall machine, eventually scrapping the wire brush design during testing when they learned that the wire bristles broke off and mixed with the grain, posing a hazard to livestock.²

During the 1930s, agricultural engineers conducted extensive tests on small pull-type combines, analyzing grain loss, speed, and performance in varying conditions. The authors of a 1936 study concluded that machine adjustments and crop conditions were more important in determining grain loss and quality of harvesting than the size or type of machine. They also noted that the small size, light-weight and use of pneumatic tires were important considerations in a region with relatively small or irregularly shaped fields. One of the questions about Corn Belt combines was their ability to handle Midwestern conditions, especially green weeds and “rank” or thick straw. Since the cutter bar was just as wide as the cylinder, the machine handled heavy crops without clogging. An engineer from the J. I. Case Company recorded strong objections to the combines, most notably that the small-sized tractors commonly used in the Midwest did not have enough power to operate the machines. According the Case engineer, “typical” farmers would be unable to operate “within the speed

² “McCormick Deering Take-Off Combine,” *Farm Implement News*, 27 March 1930; “John Deere No. 5 Combine,” *Farm Implement News*, 29 May 1930; “The Fleming-Hall Baby Combine,” *Farm Implement News*,

limits essential to efficient threshing, separating, and cleaning.” But engineers generally favored the new type of combine in spite of concerns about harvesting losses and fears that the small machines were easily overworked.³

As the engineers tested the “baby” combines in the mid 1930s, a small number of Iowa farmers used the larger models, either purchasing one or hiring a custom operator. E. M. Brubaker of Prairie City, proprietor of an implement dealership during the 1930s, had his sons custom harvest with two of these large Rumley combines, but farmers who used combines were still in the minority. Even after Allis-Chalmers introduced the All-Crop combine in 1935, their production version of the Fleming-Hall “baby” combine, binders were still more popular than combines, outselling combines ten to one. By the end of the decade, however, combine sales had overtaken binders and threshers. In 1939 combines outsold binders two to one and outsold threshing machines by eleven to one. Doyle Brubaker, who set up and adjusted combines for his father at the family implement dealership in Prairie City, noted that in 1940 “you couldn’t give a binder away; the market was gone.”⁴

Purchasing a combine could make good economic sense for a farm family. Allis-Chalmers Company introduced the Model 40 All-Crop in 1938, their smallest pull-type combine with a forty-inch cut, priced at \$345, the same as a power-take-off binder. When faced with the decision to replace a worn machine or invest in a combine, farmers could make a clear choice; purchase the older technology that was reliable and familiar or obtain a new machine with the potential for cost savings. Running a combine through the field

7 August 1930; “Allis-Chalmers Announces ‘Baby’ Combine,” *Farm Implement News*, 20 November 1930; Charles H. Wendel, *The Allis-Chalmers Story* (Osceola, WI: Crestline Publishing, 1993), 66.

³ W. M. Hurst and W. R. Humphries, “Performance Studies of Small Combines,” *Agricultural Engineering* 17 (June 1936): 249 - 250; W. M. Hurst, “The Field for the Small Combined Harvester-Thresher” *Agricultural Engineering* 16 (June 1935): 221 - 222, Discussion by F. N. G. Kranick, 222 - 223.

consumed less fuel than operating a binder, hauling the bundles, and powering the threshing machine. Furthermore, families saved money on twine and the cost of feeding a neighborhood threshing crew, commonly known as a ring.

Salesmen stressed the potential cost savings as they met farmers and spread the news about the new combines. Territory representatives visited local dealers and hosted suppers for area farmers, followed by a sales meeting. Doyle Brubaker related the selling technique used by an Allis-Chalmers representative in Iowa during the late 1930s. The local dealer provided the salesman with information about leading farmers in the area and then called on one of them at the evening meeting. After asking the farmer about how much grain he harvested and what expenses he incurred to harvest the crop, the representative would bring home the point by stating, “you know, every two years you’re buying an All-Crop Harvester and you don’t have one.” The comparison of the costs associated with binding and threshing made purchasing a new combine look more reasonable.⁵

Farmers who did not want to purchase new machines could purchase used models by the late 1940s and 1950s, easing the transition to the new technology. The Robinson family from the western part of the state bought a used Massey-Harris combine and kept it for at least two years before purchasing a new machine of the same make. The Holm family of Eagle Grove purchased a 120 acre Madison County farm in 1955, spending \$1,591 on equipment that year to commence farming in Lincoln Township. Their largest expenses included \$400 for a 1947 tractor and mounted cultivator, and \$350 for a six-year old International combine. The cash saving on the used machines was significant and allowed them minimal capital expenses. For example, the Holm family’s used machine only cost a

⁴ Doyle Brubaker interview; “Combines Gain on Binders,” *Wallaces Farmer*, 10 August 1940.

few hundred dollars in 1955, while Elmer and Darlene Meyer bought a new International combine in 1954 for \$1,750. Farmers who purchased combines frequently used them for custom work, helping to offset the cost.⁶

Farm writers compared the costs of owning a combine versus hiring one. In 1952, the staff at *Wallaces' Farmer* concluded that farmers with less than sixty-five acres to harvest should hire a combine rather than purchase one. They calculated that harvesting on a 173 acre farm with forty acres of oats and another twenty-five acres in soybeans would cost \$292.50, or \$4.50 per acre for custom, or hired work. By contrast, owners would pay about \$100 per year in depreciation on a \$1,500 combine, with another \$110 for upkeep, interest and housing the machine. Adding \$2.00 per hour for tractor and operator covering one and a half acres per hour, operating costs equaled \$1.35 per acre, costing \$87.75 to run the machine. Added to the overhead cost of \$210.00, the total harvest cost would be \$297.75, slightly more than hiring the work. The authors concluded that farmers with less than sixty-five acres would be wiser to hire their combining.⁷

Two years later *Wallaces' Farmer* published an almost identical article, this time with calculations based on seventy acres to combine, concluding that farmers who raised between sixty and seventy acres could make a combine pay, especially if they did custom work or bought a used machine. Writers from a competing magazine, *Successful Farming*,

⁵ Doyle Brubaker interview.

⁶ Quick and Buchele, *The Grain Harvesters*, 172 - 173; Keith Robinson, interview by author, 1 October 1992, Atlantic, Iowa, tape recording; Lennis J. Holm, "From Family Farm to Agribusiness" (Honors Thesis, University of Iowa, May, 1967), 115; Darlene and Elmer Meyer, letter to author, 7 September 2001; "John Deere No. 12-A Combine Paves the Way to Bigger Profits," John Deere Sales Brochure, A-534-50-8, 1950.

⁷ "Own Or Hire The Combine," *Wallaces Farmer*, 21 June 1952.

recommended that farmers who had less than eighty acres of their own and could not arrange to have another twenty acres to harvest should not purchase a new combine.⁸

The experience of Rudolf Schipull of Eagle Grove illustrates the financial considerations of combine technology. Schipull kept extensive records of his farm operation from 1939 until he retired in 1952. When he commenced record keeping in 1939, Schipull conducted an inventory of his equipment. Among his machines, he owned a 1934 McCormick-Deering binder valued at \$223 that he used for harvesting his oats. Each year until Schipull sold his equipment in 1952, he recorded the expenses for equipment repair, twine, threshing machine costs and custom combining charges for a variety of crops including soybeans, flax and clover seed.⁹

Schipull's records detail the significant expenses associated with maintaining a binder and threshing outfit. From 1939 to 1950 expenses for binder and separator repair ranged from a low of \$1.47 in 1940 for binder sections (cutting surfaces) to a high of \$28.25 in 1943. That year, Schipull spent \$17.40 for a new binder platform canvas (to convey the grain across the machine), \$1.64 for twenty-five binder sections and \$1.28 for a new separator belt. The largest equipment expense Schipull incurred was to maintain the tractor he kept to provide power for his separator. He finished paying off the machine in 1939, noting a \$400 payment in that year's expenses, and spent an average of \$77.29 for maintenance every year from 1939 to 1950, the year he bought a combine. As Schipull's records show, the threshing tractor became a problem by 1950. From 1939 through 1945, the average yearly cost to repair that tractor was \$43.42, while the costs from 1946 to 1950

⁸ "Should You Own a Combine?," *Wallaces Farmer*, 5 June 1954; "Are you losing money on machinery?," *Successful Farming*, May 1950.

⁹ Schipull papers.

averaged \$124.72. During the last five-year period of use, Schipull's repairs included replacing transmission bearings, two valves, crankcase and camshaft bearings, piston rings, a connecting rod and numerous other adjustments.

It is impossible to know if the mounting expense of operating the threshing tractor prompted Schipull to invest in a combine, but a comparison of the expenses for the old technology with the new technology suggests that, faced with sizable repair bills, the combine promised equal or lower costs. Schipull paid \$200 for one half interest in a combine after spending almost \$125 a year for repairs to the threshing tractor over five years. In addition to tractor repair, he incurred annual expenses of almost \$32 for twine and close to \$8 to repair to an aging binder and threshing machine, totaling approximately \$165 to harvest his oats. When the average annual expense of \$83.30 for custom combining soybeans from 1939 to 1951 is added to this figure, Schipull spent \$248.30 every year to conduct his harvesting, more than offsetting the cost of his share in the combine.¹⁰

In addition to machinery costs, repairs, and supplies, there were costs associated with laborers at threshing time. Providing meals was a regular expense which could fluctuate depending on how large a crop a farmer planted. In 1947 Rudolf Schipull purchased thirty-two meals for threshers during two days in August for \$21.42. Joseph Ludwig of Winneshiek County regularly purchased beer and "pop" for his threshers. In 1948 he spent \$8.50 for two cases of beer and one case of soda. While many families exchanged labor which minimized cash expenses, families sometimes hired help for threshing. Rudolf

¹⁰ The expenses for combining, binding and threshing do not include fuel, which Schipull did not itemize by type of field work. If figures for fuel were available, the cost of combining would be even more favorable compared to binding and threshing, since the latter method required a trip across the field for harvesting, picking up bundles, and at least two days of threshing. Schipull papers.

Schipull hired laborers to help with his threshing, increasing the cash costs of an already expensive operation.¹¹

Threshermen like Schipull contended with a new type of threshing ring by the middle decades of the century, which influenced farmers' decisions to purchase or hire a combine. Once farmers owned their own tractors, which a majority of Iowa farmers did by 1940, they were liberated from the need to hire a steam engine for threshing. Instead of the large rings that used steam power, farmers who threshed in the late 1930s and 1940s frequently used their own tractors, smaller threshing machines, and threshed with fewer members. In 1945 Herb Swaggart, a thresherman from Hardin County recalled his days of operating large threshing machines powered by steam engines in the early 1900s. Swaggart noted that he used to conduct two August threshing runs, one with a ring of fourteen or fifteen jobs and the second with sixteen jobs. The sixteen-family ring required the labor of as many as twenty-two men and their families. By the mid 1940s, threshing rings like the ones Swaggart knew were the exception rather than the rule. Farmers and journalists perceived a significant difference between the threshing of an earlier era and the threshing conducted on farms during the late 1930s and 1940s. With families using small threshing machines that handled six or eight jobs, farmers worked with fewer neighbors and relatives.¹²

Johnnie Westphalen's threshing experiences in western Iowa illustrate the way threshing changed. Westphalen's family participated in a twenty-seven member ring in the early 1900s, covering southern Audubon and northern Cass counties. Like Swaggart, these families threshed together for almost the entire month of August. When Westphalen and his wife, Marjorie, began farming on a rented thirty acre farm in Audubon County in 1939, he

¹¹ Schipull papers; Ludwig papers.

started a threshing operation to supplement the income from his small farm. However, the threshing rig and threshing ring Westphalen used were very different than the tools and organization his parent's knew. The younger Westphalen used a twenty-two inch McCormick-Deering threshing machine and purchased a used John Deere Model D with money he borrowed from his uncle. Westphalen utilized his "little rig" to thresh for five or six neighbors in his family neighborhood as well as for his in-laws in the Buck Creek neighborhood, finding a niche in the new rural landscape where tractors democratized threshing machine ownership.¹³

As the older threshermen died or retired, their younger counterparts could not or would not sustain interest in the older technology. Schipull, an established farmer, probably continued threshing because his equipment was unencumbered by debt. Once he paid off his threshing tractor, he only had to worry about upkeep, and when that became too onerous, he made the switch to combining. One Cass County farmer returned from military service in Korea and participated in one of these small rings for a season or two. However, he soon purchased a used combine, abandoning tradition for the advantages of harvesting on his own schedule.¹⁴

Once farmers decided to use a combine, they had to learn the best operating techniques, since operating a combine involved more than merely hitching, starting the tractor and heading into the field. When was the optimum time to harvest with a threshing machine? Each stand of grain ripened unevenly, depending on field conditions and the

¹² "Has Threshing Lost Its Glamour?," *Wallaces Farmer*, 21 July 1945.

¹³ Johnnie Westphalen, interview by author, 2 October 1992, Atlantic, Iowa, tape recording.

¹⁴ Rikoon argued that farmers continued to thresh after World War II because they "weighed the financial cost of innovation and concluded that older practices still provided the most efficient way to complete the grain

variety of seed planted. How could combine operators ensure that the oats would be ripe enough without waiting too long, risking grain loss at the cutter bar due to shattering? To prevent threshing loss due to cracked seed or underthreshing, farmers needed to adjust the distance between the cylinder and concave and set the cylinder at the proper speed for the type of crop. Similarly, the flow of air had to be adjusted to match crop conditions and the crop type to capture all of the threshed grain.

These issues, if not properly addressed, could make the difference between profit and loss and, ultimately, in the success of the technology in meeting the farmer's needs. Instructions from the manufacturer and sales staff, advice from farm periodicals and farmer adaptations helped farmers accept the combine. But the willingness of farmers to experiment on the faith that sooner or later the new machines would help them harvest with greater financial and labor savings was the most influential factor in the acceptance of this new machine.

Although farmers believed that combines could save money and labor when compared to binders and threshing machines, the transition to combines involved a few technical obstacles. A perennial debate about combine use in Iowa concerned the proper time for harvesting. According to writers in *Wallaces' Farmer*, "One problem in connection with the spread of combines is teaching the owner to avoid harvesting too soon." As long as farmers used binders and threshed their grain a week or ten days later, farmers cut grain when it was only partially ripe. "With the new machines," the journalists cautioned, "it is advisable to hold off an extra week or ten days past the binder stage." By waiting, the grain would ripen in the stand and fully develop as well as go into the bin with the proper moisture

harvest," *Threshing in the Midwest*, 153. Lenis Holm "From Family Farm to Agribusiness," 115; Robinson,

content. If the stand was in danger of lodging (falling over), or was especially weedy, then the farmer could windrow it and let it lay in the field to let it dry. The article contained information on letting the crop cure in the windrow for a few days to get it dry enough so that the combine could separate the oats from weed material (known as trash). Moist trash mixed with the grain could cause the grain to spoil in storage. Farmers needed to make sure that the crop they were storing was at 14 percent moisture content to prevent deterioration in the bin.¹⁵

The standing versus windrow debate continued in the weeks leading up to the 1942 harvest season. One writer noted that farmers disagreed about whether it was preferable to combine standing grain or to windrow it before combining. He “had almost come to the conclusion that windrowing was practically imperative with oats, perhaps as much so as for flax,” until he spoke with Glen Blanchfield of Lake City who regularly combined standing oats. While not taking sides, the author counseled farmers who used both methods. Farmers who combined standing grain needed to wait at least ten days after the time when they would normally start binding to ensure a ripe crop, noting that “ripe oats does not go to pieces as badly as we thought it would.” Windrowing required stubble just a little higher than with binder operations to keep the windrow far enough above the ground to allow the grain to dry without bending the stubble under the weight of the windrow. If the cut grain touched the ground it would not dry properly and could even mold in the field.¹⁶

Admonitions to windrow oats before combining became an annual feature in *Wallace's Farmer* by the end of the 1940s. In 1946, Merle Stansfield, a Marshall County

interview.

¹⁵ “Combines Gain on Binders,” *Wallaces Farmer*, 10 August 1940; “Pointers on Combining,” *Wallaces Farmer*, 28 June 1941.

farmer, observed “There are a lot of fellows who just can’t wait. But if you want good, heavy berries, you should let oats ripen on the stem.” Stansfield used a windrower because he believed that weeds could dry out in the windrow and prevent clogging the combine. By contrast, a Hardin County farmer argued that windrowing actually increased the likelihood that trash would get into the grain bin. The regularity of advice to windrow suggests that the process of combine adoption involved trial and error based on local conditions and operator preferences. Regardless of the method, all farmers concluded that the oats needed to be ripe before harvesting.¹⁷

The next year, *Wallaces’ Farmer* repeated the same theme of cutting only ripe grain, although author declared that windrow harvesting was the preferred method. In 1949, the editors came out in favor of windrowing, contending that it helped ensure grain quality. The next year a similar article titled “Windrowed Grain Keeps Better” echoed that finding. In spite of the editor’s strong case for windrowing, a 1951 poll found that three of five farmers who used a combine cut their grain in the stand rather than windrowing it first. Dale O. Hull, an extension engineer at Iowa State College, traveled through Iowa at harvest time. He observed that farmers who sold grain for cash tended to windrow oats. By 1959 it was clear that farmers in the northern part of the state preferred to windrow while those in southern Iowa combined standing grain. The actual practices of farmers indicate that they used machines the way they believed suited their operation rather than heeding the advice of the journalists.¹⁸

¹⁶ “No More Threshing Ring Dinners?,” *Wallaces Farmer*, 27 June 1942.

¹⁷ “Let Grain Get Ripe, Farmers Say,” *Wallaces Farmer*, 6 July 1946.

¹⁸ “Windrowing Helps Grain Quality,” *Wallaces Farmer*, 18 June 1949; “Windrowed Grain Keeps Better,” *Wallaces Farmer*, 1 July 1950; “Need Straw Next Winter?,” *Wallaces Farmer*, 21 July 1951; “Conditioning Grain For Harvesting with the Combine,” Hull papers; “Oat harvest method varies over state,” *Wallaces*

The debate over harvesting standing or windrowed grain illustrates that farmers had to select appropriate techniques to use the new technology, but farmers also made their own technological adjustments to solve problems or cut costs. Farmers who preferred windrowing had to get the grain cut and laid in a windrow, requiring an extra trip through the field with special equipment. Faced with purchasing a windrower or hiring one at an extra charge, farmers found their own solutions. Some farmers simply used their mowing machines and raked the cut grain into a windrow, although one writer noted that “ordinary mowing and side-delivering can sometimes make a terrible rope [of cut stems and grain] to handle.” Other farmers converted their binders to windrowers, blending the existing tools that were already paid for with new tools to get in the crop. The easiest way to windrow was to disable the tying mechanism on the binder, allowing the cut grain to simply slide off the machine and onto the stubble. Loyd Reisdell from Carroll County, made more elaborate modifications to his binder. Reisdell, photographed in 1942 with his “made-over binder windrower,” removed a section of the binder platform, leaving a drop-hole for the cut grain to land gently on the stubble. In the late 1940s Iowa State College experts estimated that farmers used eight times as many converted binders as windrowers as they did factory made windrowers. Charles and Minnie Havran of Benton County, purchased a new Allis-Chalmers All-Crop 60 in July, 1950 and used a modified binder for two years before bought a used nine-foot Case windrower. Farmers who combined soybeans also modified their machines. Plant material occasionally jammed in the straw rack of the All-Crop combine when the vines were rank. One farmer’s solution was to take pieces of wooden fruit crates and secure

Farmer, 20 June 1959. In 1960 the author of a brief article titled “Harvesting Oats” asked whether farmers should combine standing oats or from a windrow without offering any indication of a preferred method. *Wallaces Farmer*, 2 July 1960.

the wooden slats over the straw rack to allow the plant material to move over the rack and out of the combine while the beans fell through.¹⁹

There were other challenges in using combines that threatened their adoption. In July, 1947, Ray Gribben of Dallas County hired two neighbors to combine his wheat. One of the men spent the first day adjusting his John Deere 12-A combine for the proper threshing speed, while the other successfully used a McCormick-Deering. Everything was in order on the second day and on the third day the harvesters wanted to finish, which meant that they continued to harvest until 9:30 P.M. Gribben recorded how impressed he was with his harvesters' work ethic in that day's diary entry, but the next day he tested the crop harvested after dark and found that it was too moist to store, concluding that the grain absorbed the moist night air. In spite of his concerns about the high moisture content of the nighttime harvest, Gribben did not want to go back to threshing. The day after the harvest he did not state that he would look for a responsible thresher to do a better job than his custom cutters did. Instead, he resolved that if he had wheat to harvest next year, "I'll not permit [combine] harvesting late in evening or early morning." Gribben recognized that there were risks associated with combining and needed to be assertive about minimizing or reducing problems.²⁰

The "straw problem" was another challenge for farmers, forcing them to find new solutions to unanticipated problems created by new technology. Farm families who raised livestock needed the straw, a by-product of threshing, for bedding and manure removal.

¹⁹ "No More Threshing Ring Dinners?," *Wallaces Farmer*, 27 June 1942; Hull, "Conditioning Grain for Harvesting with the Combine"; Charles and Minnie Havran Papers, Living History Farms, Urbandale, Iowa; Doyle Brubaker interview. A businessman from Bettendorf, Iowa offered farmers free instructions for converting binders to windrowers beginning in 1940. See George Innes, "Old Binders Make Good Windrowers," *Farm Implement News*, 2 May 1940, 33.

However, the combine left the straw in the field. Farmers who used threshing machines could blow the straw into the barn or use a straw stacker to create a stack, allowing them to have the straw close to their livestock. Throughout the late summer and into the fall, farmers could then use a stationary press to bale the straw for easy handling. According to Keith Robinson of Cass County, “My dad was a little later getting a combine than others because he liked that straw pile...he liked that in the winter time for the hogs to get in there.” The straw was cheap shelter for hogs and the animals consumed any unthreshed grain in the pile. Farmers in the Irwin area of Shelby County reported in 1940 that they believed combines wasted the straw compared to threshing.²¹

The solution to the straw problem was the pick-up baler, a parallel development in harvest technology. In 1941, an observer noted that farmers were “getting around the straw problem by calling in a custom baling outfit to follow the combine.” Once families baled their straw, they could pick it up from the field with family labor and haul it to the barn or hog house for storage, using the straw as needed, just as they had done with the straw stack when they threshed. Ray Gribben hired custom balers to bale his wheat straw after his shaky combining start in 1947. After purchasing their combine in 1949, the Anderson family of Audubon County hired a custom baler to bale enough of the straw to get them through the next year. A 1951 farm poll showed that 83 percent of respondents baled their straw. Even though baling was the most common method of saving straw, farmers employed other techniques. A small minority of farmers reported using a field chopper to cut straw and blow it into a barn or other outbuilding, or make temporary storage with snow fence. Even fewer

²⁰ Ray Gribben diary, State Historical Society of Iowa, Iowa City.

farmers said that they used hayloaders or other hay tools to pick up the straw. Most farmers found that their straw problem, created by the decision to use new combine technology, could be solved by other new technology.²²

Families who used combines not only changed the type of work performed on Iowa farms, supplanting threshing with combining and straw baling, they cut the labor needed to harvest the crop, altering family work patterns. When families belonged to threshing rings almost every family member was critical for harvesting and threshing the crop, but as combines became popular, the need for family labor diminished. Before combining, even child labor was vital on farms at harvest and threshing time. Darlene Meyer of Adair County recalled that her entire family would work in the evenings to shock the grain that the men cut during the day. Young children hauled water to workers in the field before they were old enough to help drive horses or tractors on the racks for the bundle pitchers. Teenagers helped pitch bundles and scoop the threshed grain out of the wagons and into the bins. Keith Robinson's father and a neighbor drove the tractor and binder while the two Robinson boys shocked the grain. When families began to use combines, one or two people could handle the crop from the field to the bin. One Audubon County farmer used the combine while his teenage son hauled the grain in from the field and scooped it into the bins, completing the harvest of forty-five acres with just two field workers.²³

²¹ Edward O. Moe and Carl G. Taylor, "Culture of a Contemporary Rural Community, Irwin, Iowa," *Rural Life Studies* 5, (Washington, D.C.: U.S. Government Printing Office, December 1942), 39, 78; Keith Robinson interview.

²² "Getting Onto Combines," *Wallaces Farmer*, 14 June 1941; Gribben Diary; R. D. Anderson, interview by author, 7 December 2001, Des Moines, Iowa, tape recording; "Need Straw Next Winter?" *Wallaces Farmer*, 21 July 1951.

²³ Mary Neth stressed the importance of threshing as a farm survival strategy that allowed family farms to minimize expenses by exchanging labor within their communities. According to Neth, the break-up of threshing rings was a loss of community sharing that men and especially women mourned. I do not deny that farm family members valued aspects of threshing, but it is likely that they welcomed the new work more than

Of course, fieldwork was not the only work involved in harvesting. Combining saved other labor, too. Some women were happy to be free of the burden of feeding threshing crews, even the reduced crews of the late 1930s and 1940s. In many cases, women were responsible for feeding the crew an evening supper in addition to the noon dinner. Both midday and evening meals were extensive affairs, featuring several kinds of meats, vegetable dishes, pickles and preserves, and bread as well as pies and cakes. In 1940, a contributor to *Wallaces' Farmer* wrote a long article urging the "streamlining" of threshing meals. The author, "Mrs. Leslie," noted that the older generation expected the elaborate meals but that farming and rural life was different, with different tools and conveniences. She suggested that the men could go to town and have a good meal at a café, where the facilities existed to feed large numbers of people. Furthermore, the extensive home-cooked meals wasted money and were actually too much for the men. "Men haven't iron clad stomachs" she wrote, "and many a man who begins to look a bit wan around the gills and feels weak in the middle by the time the threshing is half over could come thru a season of ordinary "vittles" hale and hearty."²⁴

In 1942 the magazine backed away from "Mrs. Leslie's" position. Wartime conservation measures of gas and tire rationing provided justifications for feeding the men on the farm rather than in town. In this instance, the increased demands of wartime production, the need to make do with existing equipment and the attending social customs of threshing

they mourned the passing of the old. See chapter six, *Preserving the Family Farm: Women, Community, and the Foundations of Agribusiness in the Midwest, 1900-1940*. Elmer and Darlene Meyer, interview by author, 14 August, Bridgewater, Iowa, tape recording; Keith Robinson interview; R. D. Anderson interview.

²⁴ "Streamlined Threshing Meals," *Wallaces Farmer*, 27 June 1940.

took precedence over calls for reform. Relief from threshing meals would come with the combine.²⁵

The diminished need to feed threshers was one of the most significant changes associated with combine use. “With the decrease in large threshing rings and the like,” a writer observed in a *Wallaces’ Farmer* article from 1950, “dinners for big crews of men are becoming less and less common.” When Darlene and Elmer Meyer of rural Bridgewater began farming after their marriage in 1942, Darlene was up at 5:00 A.M. to kill and butcher the five chickens she needed for that day’s meal. When the Meyer’s purchased their first combine in 1954, a new International Model 64, Darlene no longer prepared special meals in large quantities. While combining did not necessarily change the daily bill of fare for rural dinners, women no longer fed a neighborhood crew. Instead, they focused on providing for their own family and, on some farms, assisting with the fieldwork.²⁶

Women began to play a larger role in fieldwork in the Midwest as hired men left the farm and more farmers turned to machine power. The decline in communal labor put a premium on women’s labor in some families. A photograph of a family in an oat wagon next to a combine in the August 7, 1945, issue of *Wallaces’ Farmer* included a caption describing the oat harvest as a “family enterprise” for the Gurnett family of Linn County. Mrs. Gurnett used the tractor to haul the grain from the combine to bin. On the Meyer farm, Darlene unloaded the oats, although Elmer operated the combine and hauled the grain.²⁷

As farm families with combines compressed the grain harvest season from two to four weeks into two or three days, families had more time for recreation. In a promotional

²⁵ “Feeding the Threshers,” *Wallaces Farmer*, 27 June 1942.

²⁶ “Extra Men Coming For Dinner,” *Wallaces Farmer*, 15 July 1950; Elmer and Darlene Meyer interview.

film for John Deere 11-A and 12-A combines, the fictional Sheppard family considered purchasing a combine to help them perform their harvest more quickly and at lower cost, but also for the added benefits of reduced work and increased time for family recreation. After the Sheppard family purchased their combine and successfully completed the harvest, the father, Fred Sheppard, observed “If it hadn’t been for that John Deere combine, we’d have had a month of hard and sweaty work setting up bundles and threshing.” The son replied that it only took four days to harvest their sixty acres of oats at half the cost of binding and threshing. After acknowledging that “mother” would enjoy a vacation as well as a new electric refrigerator that they planned to purchase with the savings, the family departed for a fishing trip with relatives. As the family drove away, they stopped to wave at their neighbors who were threshing just down the road. The film’s narrator concluded the dramatization by stating, “You and your family can take a vacation next year if you shorten your harvest with a John Deere combine.”²⁸

Like the fictional Sheppard family, real Iowa families prepared for a new type of lifestyle. If farm families could persuade or hire someone to milk the cows and take care of the livestock, they could justify taking a week or two holiday during the time that they previously needed for threshing. A photo essay entitled “How to Take Eight On Your Vacation” from *Wallaces’ Farmer* depicted one family’s preparations for a 1950 vacation to Minnesota for fishing and then across Canada to Seattle and back home. The Gaines family of Linn County purchased an old school bus and renovated it with numerous conveniences, including bunk beds, electric lights, window screens, a gas refrigerator and water tanks. The

²⁷ Katherine Jellison depicted the growing role for women in field work after World War II in chapter six of *Entitled to Power*; “Oat Harvest,” *Wallaces Farmer*, 7 August 1945.

final photo caption in the essay stated, “This is how they’ll start out when combining ends and the bus is ready.” One Audubon County family decided to take a fishing vacation in Minnesota after they purchased a new John Deere 12-A combine in 1949. In addition to saving harvest labor and time, the income from custom work actually paid for the vacation. Families who purchased combines, then, experienced a dramatic shift in their lifestyles.²⁹

Tenants and landlords also experienced changes when they began to use combines. The traditional arrangement of labor sharing at threshing time included arrangements for cost sharing, too. Both tenants and landlords did their own binding and split the threshing bill and twine costs. But combining defied the traditional logic of harvesting. If an owner did not own a combine and hired a tenant who did own one, the reduced labor requirements and expense of machine hiring meant that splitting machine hire costs was potentially more expensive for landlords, since they paid cash for what they formerly received as part of the tenant contract if the tenant used his own combine. When the editors of *Wallaces’ Farmer* ran a story titled “Power Farming Changes Leases” in 1946, they could only report on the problem without offering solutions. In 1950, writers at the magazine reported a variety of different solutions, including splitting the cost in half between landlord and tenant, minus the landlord’s share of fuel.³⁰

While families and communities began to adapt to changes in labor requirements of the combine, their decision to purchase a combine also played an important part in the transition to soybean culture in Iowa. While journalists debated the best way to use

²⁸ *The Sheppards Take a Vacation*, produced by Ray-Bell Films for John Deere Company, directed by Reid H. Ray, circa 1940.

²⁹ “How to Take Eight On Your Vacation,” *Wallaces Farmer*, 15 July 1950; R. D. Anderson interview.

³⁰ “Power Farming Changes Leases,” *Wallaces Farmer*, 5 October 1946; “Who Pays: Tenant or Landlord?,” *Wallaces’ Farmer*, 3 July 1948; “Who Pays For Combining?,” *Wallaces Farmer*, 1 July 1950.

combines in small grains, soybeans gained rapid acceptance in Iowa. The first soybean crops were most valuable as forage. Up to World War II, farmers used as much as two thirds of the Iowa soybean crop for hay. But wartime demands for edible oils for humans and high protein meal for livestock spurred the demand and acreage for the crop. Farmers invested in cooperative soybean mills to process the crop in Manly, Sheldon, Eagle Grove and numerous other communities, creating an infrastructure to deal with the surge in acreage from 1.25 million acres (for hay and beans) in 1939 to over 2.2 million in 1943. The wartime boom in soybean production helped create a high demand for combines. In 1942 some areas of the state had enough combines to harvest the bean crop, particularly the grain-livestock regions of the west and south, but in the rest of the state, where soybeans were most commonly grown, the number of acres per combine was quite high. In this area, each combine would need to cover anywhere from around 200 to as many as 422 acres in Emmet County to finish the harvest. While some observers predicted that soybean acreage would fall from wartime highs of over 2 million acres by half, in 1954 Iowa farmers matched their wartime production and, in 1961 they raised over 3.3 million acres, giving Iowa farmers an additional reason to purchase or hire combines.³¹

Combines were the harvesting machine of choice for soybeans, the region's newest crop, even before the machines were popular for harvesting small grains. A *Wallaces' Farmer* article from 1946 noted that farmers accepted combines as the best way to harvest soybeans, even as they continued to use binders and threshing machines for their small

³¹ Earle D. Ross, *Iowa Agriculture* (Iowa City: State Historical Society of Iowa Press, 1951), 180; Wilcox, *The Farmer in the Second World War*, 299; "We Must Have More Soybeans and Flax!," Iowa State College Agricultural Extension Service, Ames, Iowa, *Pamphlet 26*, March 1942; "Is the Soybean Boom Over?," *Wallaces Farmer*, 20 October 1945; *U.S. Census of Agriculture, 1940*, v. I, pt. 2, 121; "Combines on Beans,"

grains. Farm records show the coexistence of two types of technology for harvesting and threshing. Rudolf Schipull hired combines for flax, clover and beans in the 1940s while continuing to bind and thresh his oats. Asa T. Meelchryst threshed oats on his Guthrie County farm in the summer of 1943 but spent \$26.00 to hire a combine for harvesting his beans that fall.³²

One of the biggest challenges combine operators faced in harvesting soybeans was the problem of cracking or splitting the beans. Soybeans, like any seed crop, begin to deteriorate as soon as the outer hull cracks, causing storage problems if there are too many split or cracked beans in the bin. As early as 1942, farm journalists encouraged farmers to “Thresh Beans With Care,” recommending that operators should “reduce the cylinder speed or there will be too many “cracks” or “splits.” If there was too much chopped plant material over the sieve in the rear part of the machine, the beans “will be lost or will be returned to the cylinder and cracked.”³³

Just as the editors repeated lessons of the oat harvest, the editors also reiterated the message of making proper adjustments for soybean harvesting. Recommendations to check the cylinder speed, distance between the concave and the cylinder, and air blast were almost annual caveats. In addition to checking the grain in the tank, farmers needed to examine the stubble to make sure the cutter bar was set low enough to get the low-setting bean pods. In 1951, an expert reported that, “you can expect a 10 per cent loss when you combine

Wallaces Farmer, 15 September 1942; *Second Biennial Report of Iowa Book of Agriculture for 1954-1955*, 406; *Fifth Biennial Report of Iowa Book of Agriculture for 1960-1961*, 328.

³² Rikoon included a skillful discussion of the importance of combines in the transition to soybeans in chapter seven of *Threshing in the Midwest*. Ross, *Iowa Agriculture*, 180; Lillian Church, “Partial History of the Development of Grain Harvesting Equipment” *Information Series No. 72* (rev. ed.) (Washington, D.C.: U.S. Government Printing Office, October 1947), 51; Schipull papers; Asa T. Meelchryst papers, State Historical Society of Iowa, Des Moines, Iowa.

³³ “Thresh Beans With Care,” *Wallaces Farmer*, 17 October 1942.

soybeans...tests have shown losses as high as one-third.” Constant adjustment and oversight was the remedy for poor combining. Three years later a writer, noting that careful operation could keep combining losses to less than 5 percent, encouraged farmers to analyze their operation. By counting the number of beans on the ground in square foot blocks, farmers could determine their rate of loss. Four beans per square foot equaled a loss of about one bushel per acre while just twenty beans per square foot indicated a loss of five bushels per acre. Using the new machine to minimize losses meant maximizing returns on a profitable crop.³⁴

Industry observers noticed the shift from small grains to soybeans as well as farmers’ abandonment of binding and threshing tools and their embrace of the combine. In the fall of 1950, John Deere Company placed an advertisement in *Farm Implement News* titled “Time Out, Old-Timers.” The self-serving text evoked nostalgia and images of modernity:

“This fall, throughout the nation, the old crews have been getting together again...this time to thresh the past, to harvest the rich yield of memory, to claim and store forever the golden grain that only fellowship can sow and only time can nourish. And we of John Deere are proud to join them in their retrospect, proud to share with them their golden memories, proud that we and our John Deere dealers have been a part of the great progress in harvesting equipment they have witnessed.”³⁵

The advertisement emphasized the new prominence of farmers who purchased combines by relegating threshing to the past, highlighting festivals such as the First Annual Midwest Old Settlers-Threshers Reunion held at Mt. Pleasant, Iowa that September. Rather than playing a vital role in getting the crop from the field to the granary or elevator, threshermen were now “old-timers,” belonging to a golden yesterday characterized by intense farm labor. The

³⁴ “Does Combine Save Beans?,” *Wallaces Farmer*, 16 September 1944; “Lose One-Tenth of Bean Crop?,” *Wallaces Farmer*, 15 September 1951; “How to Save More Beans,” *Wallaces Farmer*, 19 September 1954.

³⁵ John Deere Advertisement, *Farm Implement News*, 25 November 1950.

advertiser's new world of grain harvesting was characterized by comparative ease and speed, requiring the labor of no more than two people or even performed alone with minimal sweat.

Combine manufacturers could afford to be nostalgic in 1950. Combine sales were on the rise that year and increased throughout the 1950s. In 1952 farmers reported 71,728 in use on 197,741 Iowa farms, or just over one combine for every three farms. By 1959 there were 90,027 combines on 184,866 Iowa farms or one combine for every two farms. Although the numbers of these pull-type combines for small grains and beans declined after 1959, so did the number of farms. Farmers' commitment to combining did not abate. Manufacturers introduced new self-propelled models that handled corn as well as the lesser grains, supplanting the tractor-drawn models as well as corn pickers. Farmers who participated in the reduced threshing rings yielded to combines over the course of the 1950s, either by choice or attrition. By 1960, the "old-timers" could enjoy the nostalgia of their youth and fellowship of threshing at the two-day Mt. Pleasant Reunion without a month's hard work of production agriculture.³⁶

During the 1960s tractor-drawn combines also became a memory for some Iowa farmers. With the development of a self-propelled combine that could be used for the corn crop as well as small grains and soybeans it was possible to own or use one machine to harvest all the seed crops grown on a farm. With new style self-propelled combines farmers merely had to change harvesting heads to make the switch from small grains or soybeans to corn. Farmers could drive directly into the field with a self-propelled combine instead of driving over part of the crop as they did with the tractor when pulling a combine. This meant more of the crop would be harvested. Manufacturers discontinued tractor-drawn models that

were not suited for corn harvest in favor of the true multi-purpose machine. As one industry observer in 1965 noted, the trend toward harvesting shelled corn in the field (see chapter eight) meant the end of pull-type models. Self-propelled machines accounted for approximately 35 percent of all harvesting machines shipped to dealers in the US in 1958, but by 1964 they accounted for 51 percent of all harvesting machinery shipments.³⁷

For all the hyperbole about “dry shirt” harvesting in 1940, combine advertisers based their pitch on a degree of truth. Farm families looked back with pride on their tradition of demanding physical labor, but they also anticipated a future when they could, as another John Deere advertisement commanded, “Lift the Burden of Long, Drawn-Out Harvests.” Farmers themselves reported their priorities for 1951. “This will be the last year we will cut and thresh our oats,” a Jackson county farmer stated that summer. A Dallas County farmer noted that he wanted to harvest the “quickest way possible—that’s for me.” During the 1950s, threshing with a tractor and threshing machine became obsolete. In the 1960s, a minority of farmers replaced their pull-type combines with self-propelled combines. The decision about harvesting small grains and soybeans was no longer whether or not to combine, but rather what kind of combine to use. Farm men and women who purchased or hired combines cut costs over competing technology, adapted the machines to meet their needs, reallocated time for other work or leisure, and, along with other developments on the farm, claimed a place in a new, dual crop regime of corn and soybeans.³⁸

³⁶ *First Biennial Report of Iowa Book of Agriculture for 1952-1953*, 475; *Fourth Biennial Report of Iowa Book of Agriculture for 1958-1959*, 329.

³⁷ “Scanning the Self-Propelled Combines,” *Implement and Tractor*, 21 June 1965, 27-28.

³⁸ John Deere Combine Advertisement, *Wallaces Farmer*, 17 May 1941; “Need Straw Next Winter?,” *Wallaces Farmer*, 21 July 1951.

CHAPTER EIGHT

From Picker and Crib to Combine and Bin

The period from 1945 to 1970 was a time of tremendous change in corn harvesting and storage techniques. By the late 1960s many farm families replaced mechanical corn pickers that harvested ear corn with combines that harvested and shelled the kernels off the ear in the field. Families who stored their entire crop of ear corn in the drive-through corn cribs that were ubiquitous in the rural landscape remodeled those cribs and added new types of buildings to accommodate shelled corn. They purchased drying equipment to prepare the crop for storage or sale. The bundle of corn harvesting technology was much more expensive than any technology farmers had ever contemplated in the postwar period. Converting to combines, crop dryers, and storage buildings was expensive for Iowa farmers, especially since they had a significant investment in equipment and buildings for ear corn harvesting, which made the transition a slow process.

Farmers who changed from hand picking to mechanical corn pickers as recently as the 1940s only turned to combine harvesting in the 1960s after they had invested so much in chemical and other mechanical technologies that they could no longer afford to avoid the more efficient and costly combine. Many farmers continued to use mechanical corn pickers for all or part of their crop throughout the 1960s, but the value of the new technology was apparent to farmers who wanted to maximize yields. The combine, drying equipment, and new storage structures would be the catalyst for other changes in the countryside, including increasing indebtedness and the expansion of farm operations.

Corn harvesting and storage posed major challenges for farmers in the post-World War II years. While most farmers in Iowa would have readily acknowledged the advantages

of mechanical corn picking over hand harvesting in the 1930s and during the war years, even if they did not use a corn picker, there was no such consensus about the merits of the new picker-sheller combination machines or the new combines adapted to harvest the corn crop in addition to the cereal grains, hayseeds, and soybeans that were on the market in the late 1940s and 1950s. If farmers could bring in only shelled corn kernels from the field instead of the entire ear, how would they store all of that shelled corn when their storage buildings were designed for ear corn? If they could harvest their entire crop in the course of a few days rather than a week or more, how would they keep the newly harvested but still moist corn from spoiling in the bin? With the ear corn harvest, farmers spread one load a time on top of the previously harvested corn before returning to the field, allowing air currents to move among the ears and dry the corn enough so that it could be stored without spoiling until warm weather arrived in the spring. Furthermore, new harvesting and storage techniques were much more costly than the practices they replaced.

Farmers had been eager to make the transition from hand harvesting to mechanical corn pickers in the 1930s and 1940s. The mechanical corn picker relieved farmers of what historians and contemporary observers called some of the most tedious and time consuming drudgery on the farm; harvesting ear corn by hand. When practical and reliable pickers were available in 1928, many farmers in the Corn Belt were eager to purchase them, but farm finances during the Great Depression made it impossible for many to do so. Still, farmers with large enough acreages justified purchasing a picker during the 1930s, and the wartime demand for corn coupled with labor shortages made pickers even more attractive. Labor saving machinery such as the corn pickers were extremely valuable items. As one Mahaska County farmer who harvested his corn and the crops of three other farmers stated, “with the

machine we were at it only two weeks and finished in time to go pheasant shooting.”

Potential labor savings were so great that during World War II the picker was a precious commodity. The cover of the January 7, 1943 issue of *Farm Implement News* featured a corn picker arriving on a flatbed railroad car at a small town station under an armed guard with the caption “The arrival of the corn picker.” A crowd of farmers armed with firearms, axes, rocks, and pitchforks, led by a local law enforcement official greeted the machine. The mechanical corn picker was a valued piece of equipment that helped farmers get their crop stored sooner than with hand picking with numerous social and financial benefits.¹

Corn pickers, however, were far from perfect. Next to the tractor, they were the most complicated piece of machinery farmers used, and there was a lot of work to do to get them set up and to keep them operating properly. Ray Gribben of Dallas County documented the amount of work required to prepare the corn picker for operations as well as the frequency of picker problems and the accompanying exasperation in his diary. In 1947 Gribben spent half a day just hunting for his operators’ manual for his picker, plus a full day to get his machine in operating order. He began mounting the picker on the tractor on November 3, then borrowed a chain hoist on November 4 to get the large sections mounted, and finished mounting the machine on November 6. However, when the machine was in position on the tractor, Gribben found that some of the husking rolls that removed husks from the harvested ears were not working. In Gribben’s words, these parts would “take a long time to adjust...” Getting a corn picker ready for the field was a process that could take hours or days but was

¹ Colbert, “Iowa Farmers and Mechanical Corn Pickers, 1900-1952,” 531; M. N. Beeler, “What Users Say About Their Corn Pickers,” *Farm Implement News*, 21 September 1939; Sid Dix, “The arrival of the corn picker,” *Farm Implement News*, 7 January 1943.

much more complicated and time consuming than the old work of mounting the bangboard on the wagon and hitching the team of horses.²

Farmers were not free from machinery troubles when the harvest began. Frequent breakdowns and repairs plagued farmers who used corn pickers. Ray Gribben spent ten days picking corn on his farm in 1947, but on four of those days there were breakdowns that caused him to lose part or most of the day engaged in repair. After breaking part of the hitch on the corn picker on November 14, Gribben drove to nearby Perry and Dallas Center in search of a replacement part. He purchased a part for a more recent model of picker in hopes that it would work, but on the following day had the old part repaired in Perry. In this case, Gribben lost almost two days of work with a broken machine. That December Gribben assisted with repairs when a neighbor used the machine. Gribben spent the afternoon of one day and part of another day in repairs before the neighbor broke the machine on December 13. In 1948, after a flurry of repairs in November, Gribben remarked, "...So-the old machine is up to its old ways-a few hours work-then a day's lay off..." Repeated breakdowns, both major and minor, plagued almost every farmer in varying degrees during the years they used mechanical corn pickers.³

New models were not exempt from breakdowns, although they were less likely to give trouble than older machines. Both new and old corn pickers were so complex that there were many different things that could go wrong. Joseph Ludwig of Winneshiek County incurred an average of \$15.16 of expenses each year he operated his picker from 1945 to 1965, but the years immediately before the purchase of a new picker were some of the most

² Gribben diary.

³ Gribben diary.

costly in the working life of the machine. In 1945, Ludwig made eleven repairs costing \$24.13 on his picker in January, June, October and November, with ten of those repairs during the corn harvest. Ludwig purchased new corn pickers in 1946 and 1955 but still incurred minor repair expenses in each of the years following the purchase of the new machines. Farmers such as Ludwig could expect several years of low-cost operation from new machines. The first major expenses for repair of the 1946 machine were in 1950 and significant repairs on the 1955 machine began in 1961 and continued to 1965, when Ludwig spent \$110.83 on nine repairs on October, four in November, and a final repair of the year in December.⁴

In spite of the predictable inconvenient and expensive breakdowns of mechanical corn picking, it was more attractive to farmers than hand picking. Farmers who picked corn by hand spent weeks, sometimes months, conducting their harvest. Carl Hamilton, an Iowa farm boy who grew up during the interwar years, claimed that corn picking by hand was the worst drudgery on the farm. Each ear had to be removed from the stalk and tossed into a wagon. Hand picking was not only a long day of labor, it continued over weeks or months until all the ears of corn had been gathered from the field. The longer the corn was in the field the more likely it was that some of the ears would fall off the stalks or the stalks would break in a wind, forcing the pickers to bend over to recover the crop from the ground.⁵

Many farm women were especially thankful for mechanical corn pickers. Farm families hosted itinerant corn pickers during the harvest season to help get the crop in the crib in a timely manner. Unlike regular hired men who were paid a regular wage for an entire

⁴ Ludwig papers.

⁵ Carl Hamilton, *In No Time At All* (Ames: Iowa State University Press, 1974), 78-84.

year, farmers paid hired corn pickers by the bushel they picked, with the family furnishing room and board for the duration of the harvest. Regular hired men did other farm work when it was raining or it was too muddy to get into the field, but not the corn pickers. Instead, they waited inside for conditions to improve in the field. Imogene Hamilton dreaded picking season in the age of hand picking, when she would have to deal with “a bunch of corn pickers loafing around the house.” Carl Hamilton noted that many of these men performed their work admirably, but “they were not always the kind of fellows you would invite in for Sunday dinner. The extra work of hosting these men as ‘house guests’ for a few days of nasty weather was not appreciated.” Even under the best conditions, feeding pickers and cleaning up after them in addition to the farm woman’s regular duties was onerous. As one Wisconsin woman stated, no one mourned the end of the hand corn picking era, “And mother mourned it least of all.” Two southwestern Iowa women contrasted the days of feeding up to seven men three meals a day for weeks. Instead of having meals ready before daylight and scrambling to get a pie baked by late morning, one woman whose family owned a picker was able to go to town in the morning and help a neighbor butcher chickens and only feed one extra man at dinner time.⁶

At the conclusion of the corn harvest, most farmers then spent the following year feeding the corn to livestock. In some areas of the state there were stronger markets for cash grain, but corn was generally most profitable when fed to livestock. For hogs, many farmers simply tossed ear corn into the hog lot and let the animals strip the cobs, but the days of feeding shelled corn were passing. Scientists as well as farmers understood that animals

⁶ Hamilton, *In No Time At All*, 82-3; Beth Wilcoxson, “We’ll take machines,” *Wallaces Farmer*, 20 October 1956; “Thru Picking By Thanksgiving?,” *Wallaces Farmer*, 16 November 1946.

received more of the nutritive value from the corn when it was cracked, or ground into finer particles. Over the course of the winter, spring, and summer, farmers often hired someone to visit their farms and shell corn on a periodic basis, and the farmer would then grind it as needed to maintain a supply of livestock feed.

In the 1940s and 1950s this system of mechanical picking and the periodic work of grinding feed began to change. Farmers realized increased yields, due to other farm practices such as fertilizing and using hybrid seed. They stored corn in aging buildings designed for small crops. Many buildings had been neglected during the Depression and were in need of updating. Farmers struggled with insect pests that caused ears to drop off the stalk before harvest, and they endured years of corn with high moisture content at harvest time which threatened the crop with ruin. But in the postwar Corn Belt there were new harvesting machines that harvested the kernels rather than the entire ear. It was possible to use a mechanical dryer to speed the drying process. These changes prompted farmers to consider new techniques.

During World War II and the years immediately thereafter, farmers found that they had larger corn crops than ever before. In November, 1948 the editors of *Wallaces' Farmer and Iowa Homestead* proclaimed that "Corn Floods Iowa Farms." This was the biggest corn harvest in the state's history, and farmers were caught without adequate storage. While corn acreage was up from the 1947 crop year, the biggest reason for the gain was excellent rainfall and heat at the proper time in the life cycle as well as a dry fall that was ideal for a maturing crop. In 1947 corn yields were low, with a statewide average of thirty and one half bushels per acre, but in 1948 the state average was sixty-one bushels per acre. According to farm journalists, the permanent corn cribs were filled early, leaving farmers to fill the driveways of

their cribs and to construct a variety of temporary structures to hold the harvest. Another record crop in 1952 had farmers scrambling for storage space.⁷

The increased yields of the 1940s and 1950s were part of a trend that began in the late 1930s and continued during the war years. While corn yields were not increasing dramatically each year, they were higher in the 1940s and early 1950s than they had been for most of Iowa's history. Farmers of the 1920s could expect yields from the upper thirties to the low forties, while yields in the 1930s were more varied. From lows of twenty-eight and thirty bushels per acre, in 1934 and 1936, respectively, to highs in the low fifties in 1939 and 1940, farmers had seen their yields increase. They benefited from the universal adoption of hybrid corn by the early 1940s and, to a lesser extent, increased fertilizer use. (See chapter three.) Farmers recognized that increased yields were possible in the future with the proper use of technology.⁸

The shortage of corn storage space was not just a problem of increased production, but also of a lapse in construction due to agricultural depression in the 1920s and 1930s. There had been comparatively little new construction on Iowa farms during the worst years of the Great Depression compared to the period from 1900 to 1920, when farmers enjoyed an unfamiliar degree of prosperity. During the depression crop prices were at record lows and, in many cases, there were record poor yields. Families struggled just to stay on their farms. In many cases improvements to buildings and fences were out of the question. Farmers

⁷ "Got Enough Cribs?," *Wallaces Farmer*, 4 September 1948; "Corn Floods Iowa Farms," *Wallaces Farmer*, 20 November 1948; *Forty-ninth Annual Iowa Year Book of Agriculture, 1948*, 10; "Need Another Crib for Extra Corn?," *Wallaces Farmer*, 18 October 1952.

⁸ Annual corn yields are included in the annual and later biennial editions of the *Iowa Year Book of Agriculture* and are also accessible on the web site: www.nass.usda.gov/ia/historic/crn1866.txt.

owned aging corn cribs and granaries and too few of them when prices and production increased during and after World War II.⁹

When the war ended it was possible for farmers to consider building new cribs, in large part because of federal farm policy. In 1942 Congress guaranteed farmers supported prices for many commodities and passed the Steagall Amendment that provided for the continuation of support prices at wartime levels for two years after the war. This promise of protected prices gave farmers a degree of security that they had never experienced. Congress extended the provisions of the Steagall Amendment well into the 1950s, guaranteeing a degree of predictability in income that allowed farmers to consider making investments in their farmsteads, including permanent and temporary corn cribs.

In the 1940s and 1950s many Iowa farmers were willing to invest in new corn storage buildings. The combination corn crib and granary was the ideal corn storage building. The postwar cribs looked much like prewar models. The center driveway ran from gable end to gable end and rooms on either side of the drive called pens for storing ear corn or shelled corn. The new cribs, however, differed in two major respects. First, the floor plan of new cribs was often larger than the cribs constructed during the “golden age” of farming from 1900 through the 1910s. Modern cribs also included more overhead grain storage, which meant they were often taller than older cribs. As a writer for *Wallaces' Farmer* noted in 1948, there were few “modern” corncribs in the state. The center driveways of the older corn cribs were designed for horse and wagons, not trucks. Furthermore, few cribs were set up to handle corn with high moisture content, which was a perennial problem of the late

⁹ Elmer Powers' diary is an excellent example of how one Iowa family struggled to stay on the farm. H. Roger Grant and Edward Purcell, coeditors, *Years of Struggle: The Farm Diary of Elmer G. Powers* (Ames: Iowa State University Press, 1976).

1940s. A few modifications to the corn crib plans, however, allowed farmers to create cribs that testified to new-found prosperity.¹⁰

The cost of these new corn cribs varied, but they were the most expensive kind of storage farmers could buy in the 1940s and early 1950s. As Earl Van Doneselaar of Mahaska County commented, “The kind of crib most of us want costs more than a dollar per bushel of crib space if you hire the labor,” a concern that likely prevented many farmers from building permanent cribs. Van Donselaar built a traditional style crib but saved money by doing the labor himself, while other farmers used rough cut, local oak lumber or recycled lumber from other buildings to build their ideal crib. *Wallaces’ Farmer* staff members photographed and highlighted many of these cribs in the magazine in the late 1940s and early 1950s. Many of these buildings featured curved gothic roofs made with laminated rafters or gambrel style rooflines. As one writer noted in the early 1950s, “you see quite a number of wide-driveway, overhead bin type cribs under construction.” Expenses associated with these new buildings are indicated in farm record books. In 1949 Melvin Laughlin of Hardin County built a new crib for \$1,702.25, while Rudolf Schipull constructed one that same year for \$6,792.25. Many farmers spent such large sums because these buildings reflected older ideas and traditions about what constituted proper corn storage. After years of privation and struggle, farmers had high yields and good prices and could construct the “dream crib of the 20s and 30s,” signifying their success and perseverance. New cribs equaled or exceeded the size of the barns on many farms.¹¹

¹⁰ “How Many Buildings Are Modern?,” *Wallaces Farmer*, 7 August 1948.

¹¹ Al Bull, “What Kind of Crib Do You Need?,” *Wallaces’ Farmer*, 6 September 1952. For examples of the boom in corn crib construction and the types of buildings farmers erected, see the following articles in *Wallaces Farmer*: “You Can Still Plant Early Potatoes,” 3 April 1948; “How Many Buildings are Modern?”; “Got Enough Cribs?”; “Can Seal Corn in Round Cribs,” 2 October 1948; Al Bull, “What Kind of Crib Do You

Farmers who were open to new ideas about what constituted a good permanent crib could try new styles designed by agricultural experts from the private sector or the land grant colleges. The Quonset building associated with the military during World War II became a feature on Iowa farms for a variety of purposes, including storage for equipment and grain. In 1952 W. R. Mitchell of Grundy County constructed a Quonset as a granary, complete with a forced air drying system. Agricultural engineers at Iowa State College also drafted building plans for the Midwest Plan Service, a consortium of engineers from land-grant colleges who offered low-cost plans to farmers that matched Midwestern conditions. The Midwest Plan Service first offered corn crib plan Number 73281 in 1953. The crib was rectangular, with two pens running the length of the building separated by an A-frame center alley for air circulation. Hatches on the roof allowed for farmers to use portable elevators to move ear corn into the crib, just as they would a more traditional crib. These buildings were suited for natural air drying or farmers could use a fan in one of the gable-end A openings to force air through the cribbed corn to speed drying. These cribs did not become popular, however. The timing of these new buildings coincided with the rise of harvesting shelled corn. Farmers who built new buildings in the mid 1950s and into the 1960s preferred to build storage for shelled corn.¹²

Despite the attention focused on new structures, the most common new type of corn storage was the temporary crib. Temporary cribs were expected to last from one to four seasons and were made from inexpensive materials and erected in the simplest manner.

Need?," 6 September 1952; "Where To Put Corn?," 15 August 1953. "When you build corn storage," *Wallaces Farmer*, 17 July 1954; "When you build corn storage," 7 July 1954. Melvin Laughlin papers, State Historical Society of Iowa, Iowa City; Schipull papers.

¹² For Quonset buildings see: "Forced Air Drying For Cribs?," *Wallaces Farmer*, 16 August 1952; Quonset advertisement, *Wallaces Farmer*, 19 September, 1953. For the MWPS structure, see: "Crib Built For Drying Corn," *Wallaces Farmer*, 19 September 1953; "When you build corn storage," *Wallaces Farmer*, 17 July 1954.

Farmers often used round posts or dimension lumber and snow fence or woven wire fence to contain ear corn and to keep most of it off the ground. Sometimes temporary cribs were the height of several rows of snow fence. These cribs varied in size and shapes; square, rectangular, and round. William Beardsley of Decatur County made a floor for his snow fence crib and even added a roof from an old steel grain bin. Other farmers such as Fred Beier of Buchanan County built a temporary crib in the driveway of his permanent crib. He allowed space on either side of the new crib for ventilation and gained the benefit of a roof that was already paid for. Melvin Laughlin prepared for his extra storage demands in September, 1946 by purchasing fifty feet of snow fence or wire cribbing and lumber, costing him \$17.76. Laughlin's low investment suggests that temporary cribs were an attractive solution because they were inexpensive compared with the expenses for the cribs Laughlin and Rudolf Schipull built in the following years. Corn stored in temporary cribs, however, was more susceptible to moisture or rat damage than corn stored in permanent cribs, but the low first cost was a way to ease cash flow problems.¹³

Some farmers constructed portable cribs to meet their livestock feeding needs. In the fall of 1951 Carl Anderson of Washington County built cribs ten feet wide and thirty-six feet long in a pasture for feeding hogs. He set posts four feet apart and braced them across the narrow width of the crib to keep it from bowing under pressure from the ear corn, then used snow fence for the sides. In 1952 he rolled up the snow fence, removed the braces, pulled the posts out of the ground, and moved the crib to a new pasture. Anderson's crib required reassembly on the new site, but other farmers around the state solved that problem. They

¹³ "Need Another Crib For Extra Corn?," *Wallaces Farmer*, 18 October 1952; Laughlin papers.

built cribs on skids, or runners, with wire mesh or lumber sides, making it easy to move empty cribs around the farm to facilitate pasture feeding.¹⁴

For all the flurry of construction of new and temporary cribs during the 1940s and 1950s, few farmers considered the implications of new harvesting machines that were on the market in those years. The problem, according to the writer for *Wallaces' Farmer* in 1954, was that the old-style crib was not necessarily the best thing for the future. He asked farmers if the old style crib “will fit your corn harvesting methods and corn storage needs in the 1960s and 70s?” By the mid-1950s farmers had more choices in how they could harvest their corn crop. The mechanical corn picker was a proven item in the minds of most Iowa farmers, but new machines were on the market in the 1940s and 1950s. The picker-sheller was simply a corn picker with a shelling unit attached, but the combine for corn was something new. John Deere introduced the first self-propelled combine adapted for corn in 1955. The combine with corn harvesting head enabled farmers to harvest only the corn kernels, leaving the cobs in the field.¹⁵

The picker-sheller was the first of the new harvesting machines introduced. The Massey-Harris Company pitched the picker-sheller to veterans returning from World War II in a 1946 film titled “Into Tomorrow.” The protagonist was a veteran returning to the farm who asked what kind of future he could expect in agriculture. The veteran viewed the self-propelled picker-sheller, a machine that resembled a corn picker in the front but also had a shelling apparatus on the back, which separated the cobs and husks from the kernels of corn. Like manufacturers in most sectors of the immediate postwar economy, Massey-Harris

¹⁴ “Need Another Crib for Extra Corn?,” *Wallaces Farmer*, 18 October 1952; “Ear Corn...where you want it,” *Wallaces Farmer*, 4 September 1954.

¹⁵ “When you build corn storage,” *Wallaces Farmer*, 17 July 1954.

presented an optimistic view of technology in which people who used new products would enhance their lifestyles in the future. In their vision of tomorrow, new equipment in corn harvesting, haymaking, and small grain harvesting would be the technology that would give young people a future on the farm.¹⁶

Farmers who used picker-shellers could expect several advantages over those who continued using mechanical corn pickers. One of the most important changes was the timing of the harvest. Farmers with picker-shellers could harvest earlier when the corn in the field had higher moisture content which allowed them to harvest more of the crop. As corn dried in the field the ears were more likely to drop to the ground beyond the reach of mechanical pickers. The problem of ear drop became a much bigger issue in the 1940s and 1950s as farmers contended with infestations of a new pest, the European corn borer, which weakened both the ear shanks that held the ear to the stalk as well as the stalk itself. The longer corn stayed in the field the more risk that high winds could knock stalks over or force ears to drop, especially in infested fields. Harvesting machines also created their own losses. Pickers inadvertently shelled some of the kernels off the ear as it moved through the machine and into the wagon that trailed the picker. This problem was worse in dry conditions. Harvesting corn early at high moisture content with a picker-sheller allowed farmers to get more of the crop from the field to the crib.

Purchasing a picker-sheller made financial sense for farmers who wanted to get the most out of their harvest or harvested many acres of corn. Harold Folkerts of Butler County invested in both a picker-sheller and drying facilities because his corn yields were so high

¹⁶ "Into Tomorrow," produced by the Calvin Company for Massey-Harris Company, directed by Reese Wade, 1946.

that he would have otherwise had to build new, expensive corn cribs. Folkert reasoned that the investment in a new machine would actually save money, since the cost of the picker-sheller and dryer was less than the cost of cribs. Iowa State College engineers reached the same conclusion the following year when they recommended that farmers who harvested more than 125 acres of corn could use a picker-sheller for less expense than mechanical picking and storing ear corn. Howard Sparks of Story County was in an ideal situation for converting to a picker-sheller in the early 1950s. He needed to replace a worn out picker and his landlord invested in storage bins for shelled corn. Sparks claimed that the harvest was easier and allowed him to reduce harvest losses.¹⁷

The picker-sheller was especially popular in the north central part of the state because farm families there raised more corn for sale as grain than for livestock feeding. Farmers testified about the advantages of the picker-sheller, especially their ability to harvest early and labor savings. An optimistic young Webster County farmer asserted that “The picker-sheller is the coming thing...It’s lots less work and handling [of grain].” Albert Boes of Carroll County used a picker-sheller on eighty-five acres of corn in 1954 and harvested by himself. He was also able to begin harvesting at 30 percent moisture content, allowing him to get more ears while they were still on the stalks and to avoid losses due to harvesting. John Johnson of Buena Vista County also favored harvesting at approximately 30 percent moisture with his picker-sheller. He harvested seventy-five acres of a total of 800 acres in 1954 without any assistance; a remarkable feat compared to the hand harvesting that was still

¹⁷ “What They Say On Picker-Shellers,” *Wallaces Farmer*, 5 September 1953; Floyd L. Herum and Kenneth K. Barnes, “What’s the Best Way to Harvest Corn?,” *Iowa Farm Science* 9 (July 1954); Sherwood Searle and Vernon Schneider, “Here’s why we like Field shelling,” *Successful Farming*, October 1953. See also C. H. Van Vlack and Hobart Beresford, “The Picker-Sheller: Its Advantages and Disadvantages,” *Iowa Farm Science* 8 (July 1953).

popular at the beginning of World War II. Similarly, Clifford and Wayne Rabe of Sac County harvested with a picker-sheller because, according to Clifford, they “don’t like to work.” This tongue-in-cheek reference to labor savings reflected a real benefit of the picker-sheller. By leaving the cobs in the field, hauling costs could be reduced by roughly half.¹⁸

Moving shelled corn rather than ear corn meant that there was less bulk and fewer trips from the field to the storage building, a major advantage during a period of scarce labor. It was easier to utilize family labor or part time help rather than relying on a hired man to do the hauling. Fewer trips also meant less fuel consumption. Iowa State University extension specialists calculated that it cost farmers \$.25 cents per bushel to move shelled corn compared to \$.32 for ear corn. This small savings might seem small, but it was significant when multiplied by several thousand bushels. A farmer who harvested sixty acres of fifty bushels to the acre corn might not see the savings of \$210 enough to warrant investing in a combine, but a farmer with 200 acres of corn at fifty bushels to the acre could save approximately \$700, roughly 10 percent of the purchase price of a new combine in 1962.¹⁹

Reducing labor requirements and hauling costs were only part of the advantages of new technology. An equally important issue was the need to get as much of the crop into storage as possible. Concern about getting every kernel became even more compelling in the 1950s because farmers spent more money to raise a crop than they did before World War II. As detailed elsewhere, farmers began to apply commercial fertilizer to crops to get higher yields than they could have by simply using their traditional crop rotation systems. They used herbicide to control the weeds that competed with crop plants for moisture, sunlight,

¹⁸ “Corn storage plans,” *Wallaces Farmer*, 6 September 1958; A. W. Ranniger, “Use picker-sheller and dryer?,” *Wallaces Farmer*, 17 September 1955.

¹⁹ “How will you harvest corn?,” *Wallaces Farmer*, 15 September 1962.

and soil nutrients. They also invested in insecticide to control crop pests that preyed on the root systems and stalks of corn and other crops. These expenses made it all the more important for farmers to preserve as much of the crop as possible.

Combine promoters addressed the same concerns about minimizing harvest losses and early harvesting as the picker-sheller promoters had just a few years later. As early as 1950 agricultural engineers worked to develop a harvesting attachment, called a corn head, for ear corn that could be mounted on a self-propelled combine. In 1955 John Deere Company introduced the first corn head on the market, the Number 10. The new corn head could be mounted on self-propelled combines in the place of the attachment head for cutting small grains or other seed crops such as soybeans. “Corn combining is here---and here to stay,” boasted John Deere advertisers in the summer of 1956. According to the company, farmers who used combines cut their shelled corn loss by 75 percent and ear corn loss by 50 percent compared to mechanical pickers.²⁰

The reality of combining may have been less awe-inspiring than advertisers claimed, but it was still impressive. Farmers who used pickers expected to lose about 10 percent of the crop in the field, which meant that they would either have to go back and pick up ears off the ground by hand or turn livestock into the field to consume what was left behind. Earlier harvesting with a combine at higher moisture content of 25 to 30 percent provided an important edge over using a picker and harvesting at approximately 20 percent moisture. With a picker-sheller or combine, farmers could expect to lose only 6 percent of the total crop. Clarence Wolken of Marshall County used a combine in the late 1950s and claimed

²⁰ The following articles from *Agricultural Engineering* 36 (December 1955) describe the technical development of the corn head: L. W. Hurlbut, “More Efficient Corn Harvesting”; “Laboratory Studies of Corn Combining”; C. S. Morrison, “Attachments for Combining Corn.” John Deere 45 Combine and Corn Attachment advertisement, *Wallaces Farmer*, 4 August 1956.

that “You can start harvest earlier in the fall, and get away from ear drop.” In 1963, Paul and Gordon Christensen of Boone County purchased a new corn combine. They had used a picker-sheller since 1959, and, according to Paul Christensen, “saved a lot of corn by harvesting earlier.” He also asserted that “we even saved more corn with the combine.” Marvin Bacen of Humboldt County testified that “You can pay for a combine just from the difference in field losses.” By spending more for a new harvesting machine, farmers could expect to earn more by harvesting a greater percentage of their crop.²¹

Harvesting shelled corn also cut costs after the harvest, too, since it was no longer necessary to hire custom shellers to visit their farms and shell ear corn. Shelling was not an expense normally associated with harvesting, since farm families incurred shelling costs over the course of the year as they depleted stocks of shelled corn. Shelling and grinding corn was the best way to prepare it for feeding, since livestock utilized more of the nutritional value of the grain when it was cracked. This periodic expense was no longer necessary if farmers harvested shelled corn.

For all the advantages and promotion of picker-shellers and combines, farmers did not rush to adopt this new technology in the second half of the 1950s and the early 1960s. Most farmers simply did not have the kind of acreage to justify purchasing a combine unless they were prepared to do extensive custom harvesting. Two Grundy County farmers interviewed at the Farm Progress Show in 1959 estimated that a farmer would “need about 300 acres [of corn] to justify owning one.” That same year agricultural engineers estimated a lower acreage threshold of 200 acres of corn for owning a combine, which only suited the

²¹ “Pick corn when you’re ready,” *Wallaces Farmer*, 15 August 1959; Jim Rutter, “Field shell your corn?,” *Wallaces Farmer*, 5 September 1959; “A sign of the times---combining corn,” *Wallaces Farmer*, 3 October 1964; Norman West, “Which way to harvest corn?,” *Wallaces Farmer*, 14 August 1971.

needs of a small minority of Iowa farmers. The discrepancy between the perception of the two men at the farm progress show and the carefully calculated figure of extension experts revealed the gulf between the majority of farmers who could not envision a profitable use for a combine and the minority who could afford to study the acreage threshold. Farmers with large acreages were often the first to purchase combines. Clarence and Lester Wolken of Marshall County began using a combine in the late 1950 to harvest their 150 acres of corn. A survey conducted in 1965 indicated that approximately one third of farmers who, like the Wolkens, planted 150 acres or more of corn would harvest at least part of their crop with a hired or purchased combine. By contrast, only 10 percent of farmers with less than 150 acres of corn that year planned to harvest shelled corn. Most farmers agreed with the Grundy County farmers at the Farm Progress Show that combine harvesting was impressive, but was someone else's business.²²

The boom in combine harvesting began in the mid-1960s, almost ten years after combines for corn were on the market. In 1964 Iowa farmers harvested only 13 percent of their corn acres with combines, but in 1967 they used combines on 32 percent of the state's corn acreage. By 1968, farmers used combines on 35 percent of Iowa's 9.7 million acres of corn, with picker-shellors responsible for harvesting another 8 percent of corn acres. At the end of the 1960s, over half of the corn crop was harvested as shelled corn, a significant change from the beginning of the decade.²³

High costs accounted for part of farmers' reticence to purchase combines. The farm records of Joseph Ludwig indicate the high capital requirements of making the transition

²² "Field shell your corn?," *Wallaces Farmer*, 5 September 1959; "Outside Stuff," *Wallaces Farmer*, 17 October 1959; "Trend is toward more field shelling," *Wallaces Farmer*, 28 June 1969.

²³ "Trend is toward more field shelling."

from the corn picker to combine. Ludwig purchased two new corn pickers in the years after World War II, the first in 1946 and the second in 1955. These machines cost \$943.23 and \$1,300, respectively, making them some of the most expensive machines Ludwig ever purchased for his farm. However, in 1966 he invested \$8,600 in his first self-propelled combine for harvesting corn, small grains, and soybeans. While this machine was capable of harvesting a greater variety of crops than his older corn pickers, the expense was more than the cost of a new corn picker and new small-grain combine put together, even at 1966 prices. Ludwig's new 1966 machine may have had more capacity than either a corn picker or combine, but it was still a sizable investment when compared to the older technology.²⁴

Just as the first cost of a combine was greater than that of competing technology, so were operating costs. The impact of the new high priced machines on farm operations is clear when comparing maintenance and repair costs. Corn picker repairs were often literally nickel and dime expenses. Farm records show that many farmers often spent less than a dollar or two at a time, totaling a few dollars per year. Joseph Ludwig spent an average of just \$15 per year on corn picker repair from 1945 to 1965. By contrast, combine repair and maintenance was costly. Ludwig spent an average of \$98.76 per year from 1966 to 1970 on his new combine. Iowa State University economists estimated that repairs and depreciation costs would total approximately 14 percent of the original cost of the machine. Calculated this way, Ludwig's \$8,600 combine was actually a \$9,804 investment.²⁵

The most significant obstacle to harvesting shelled corn with combines or picker-shellers was the problem of how to store shelled corn. The majority of farmers were

²⁴ Ludwig papers.

²⁵ Ludwig papers; Monte Sesker, "What it costs to own a combine," *Wallaces Farmer*, 14 September 1968.

equipped to store ear corn, not shelled corn. The writer for *Wallaces' Farmer* who asked farmers in 1954 if the old style crib “will fit your corn harvesting methods and corn storage needs in the 1960s and 70s?” addressed an important issue. While the capital outlay for new harvesting equipment was high, it was compounded by the fact that farmers who harvested shelled corn needed new storage buildings and special drying equipment. New storage was expensive. In the early 1960s, new driveway style cribs cost as much as \$1.25 per bushel and metal bins cost as much as \$.35 per bushel. One Story County family that built an old-style crib in 1956 converted it to shelled corn storage just three years later. As Ralph Gerlach explained, “We had no idea when we built it to hold ear corn that we would switch to using a picker-sheller so soon.” Most farmers were trapped with buildings designed for an earlier era. According to Ken Smalley of Johnson County, “Farmers already had these cribs and they felt like they had to use them.” As a result, they continued to use the harvesting machines that matched their infrastructure.²⁶

Remodeling old corn cribs was one of the most attractive ways to get storage for shelled corn throughout the 1950s and 1960s. The common drive-through cribs were the most obvious choice for conversion to shelled corn storage. If the crib was in good condition, farmers and experts reasoned, it was simply a matter of strengthening the floors and sides while making it tight enough to keep the grain in. To convert a crib, farmers added lumber wind bracing across each half of the crib. To keep the building from expanding outward under the pressure of the shelled corn they added tie rods through the crib and secured to lumber on the outside of the crib. Lining the crib with plywood also helped brace

²⁶ “When you build corn storage,” *Wallaces Farmer*, 17 July 1954; Dick Hagen, “Remodeled cribs can double your storage,” *Wallaces Farmer*, 3 October 1959; “Twice as much corn in the crib,” *Wallaces Farmer*, 1 October 1960; Marsha and Ken Smalley, interview by author, 21 June 2004, Iowa City, Iowa, tape recording.

the structure. Finally, they enclosed the building with plywood, boards, or sheet metal. If the crib was not on a concrete foundation, the floor joists needed to be reinforced to carry the heavier load.²⁷

Farmers who wanted to change storage facilities liked the low cost of crib remodeling. As Harry Wassenaar of Jasper County explained, “Converting our old crib was the cheapest way” to get more storage and convert to harvesting shelled corn. Delmar Van Horn of Greene County was one of the first of many farmers featured in *Wallaces’ Farmer* who remodeled cribs. Van Horn claimed that he spent \$470 in materials to convert his entire 4,000 bushel ear corn crib to a building that would store 8,000 bushels of shelled corn. The materials cost \$470, or roughly \$.06 per bushel. He did not note what the bill was for carpentry, but the total cost for new construction was approximately \$.25 per bushel. Clarence Wolken and his son Lester of Marshall County converted a crib in 1958 for approximately \$.07 per bushel by using salvaged lumber and their own labor. In 1959 they hoped to remodel another crib for \$.05 per bushel in materials. Without salvaged lumber, farmers could expect to spend approximately \$.15 cents per bushel for supplies. As long as the labor cost did not exceed \$.10 per bushel, remodeling was cheaper than new construction. These kinds of savings made the transition to shelled corn storage affordable for many farmers.²⁸

Remodeling corn cribs was only one option for farmers who wanted to cut costs on shelled corn construction. Farmers could convert obsolete buildings into storage space. In

²⁷ “Remodelling Corn Cribs For Small Grain Storage,” *Agricultural Engineers’ Digest*, AED—12, n. d., Records of the Midwest Plan Service.

²⁸ “Converting cribs to shelled corn storage,” *Wallaces Farmer*, 2 September 1961; “Store shelled corn in remodeled cribs,” *Wallaces Farmer*, 2 August 1958; “Pick corn when you’re ready,” *Wallaces Farmer*, 15 August 1959; Frank C. Beeson, “Lined cribs make shelled-corn storage,” *Successful Farming*, October 1959; “Convert corn crib to shelled corn bin?,” *Wallaces Farmer*, 17 August 1963.

1954 Floyd Doxtad of Ida County invested \$100 in reinforcing an old hog barn for shelled corn storage. The iconic barns of the horse-powered, mixed farming era were also good candidates for remodeling. Willis Scott of Hamilton County remodeled his barn that was designed for hay storage to grain storage. He removed a dozen horse stalls and feeding areas for cattle to make room for 42,000 bushels of shelled corn. He removed the second floor hay mow, poured fifty yards of concrete to make a four inch thick floor to support the grain, and divided the building into three grain storage bins. Danny Bohrofen of Keokuk County owned an unused barn with an overhead hay mow and horse stalls and milking stanchions on the ground level. “The barn was idle,” he noted, “and I was paying taxes on it,” making it a candidate for demolition or remodeling. Bohrofen altered the barn in stages, first making the stalls and stanchion areas into bins for 16,000 bushels, then adding overhead bins in the mow to hold 7,500 bushels. At harvest time, he filled the bins with augers. These kinds of modifications allowed farmers to make the transition from ear corn storage to grain storage in the most economical manner.²⁹

The modification of older cribs and farm buildings was a way for farmers to minimize expenses, but new grain storage buildings such as grain bins became common on farms as more farmers harvested shelled corn. Steel grain bins were distinctive buildings characterized by their cylindrical shape, conical roof, and corrugated steel siding. On the inside, the bins were equipped with ventilation shafts, and bins for drying often had perforated floors to allow heated air to be forced up through the grain. Unlike corn cribs, there was never any intention of holding ear corn in these new-style bins or having separate

²⁹ A. W. Ranniger, “Use picker-sheller and dryer?,” *Wallaces Farmer*, 17 September 1955; “From cow barn to corn bin,” *Wallaces Farmer*, 21 October 1961; “Converts dairy barn to corn storage,” *Wallaces Farmer*, 6 February 1965.

spaces for ear, shelled, or cracked corn. Bins were strictly for shelled corn, grain, or soybeans. Although grain bins were on the market in the early 1900s, few farmers invested in them because most corn cribs or granaries included enough capacity for as much grain as farmers produced in the era of mixed farming and either hand or mechanical corn picking.

Grain bins were structures of industrial agriculture, just as combines were machines of industrial farming. The largest and most highly mechanized farms were often the most likely farms to boast of new grain bins. A 1956 advertisement for the Behlen Manufacturing Company for cribs, bins, and dryers indicated the size of operation in which grain bins could be most successfully utilized. Cedar County farmer Carl Levsen and his three sons (all in their thirties) farmed 700 acres, of which they planted 250 acres in corn. They installed eight grain bins with a total capacity of 25,000 bushels and owned seven more 3,200 bushel bins that they had not yet assembled. According to the advertisement, Levsen emphasized cutting operating costs and marketing quality products. “We call it industrialization,” Levsen and the advertisement copywriters proclaimed, suggesting that contemporary farm operators would have to borrow from the world of business management to survive. The Behlen Company emphasized the role that grain storage could play in industrializing agriculture by changing the farmstead landscape.³⁰

While the Levsen family represented the “think ahead” mentality espoused by the Behlen Company, most farmers resisted the move to new storage. A 1958 poll of Iowa farmers indicated that 98 percent stored ear corn in cribs while only 21 percent stored shelled corn in bins. The numbers total more than one hundred because some farmers stored corn both ways. When asked if they considered any changes in their storage systems, 83 percent

³⁰ Behlen Manufacturing Company advertisement, *Wallaces Farmer*, 21 July 1956.

of Iowa farmers responded that they did not. Disinterest in change reflected the fact that most farmers did not have the acreage to justify purchasing a picker-sheller or combine and therefore had little incentive to change. Even farm management specialists who advised farmers in a *Wallaces' Farmer* column counseled farmers with average or small sized farms to avoid the shelled corn harvest and grain bins. "Don't invest too much in buildings and equipment on a 120 [acre farm]," counseled a bank president from Schleswig, Iowa. Ear corn harvesting and temporary cribs made from picket fence were a better option for the majority of Iowa farmers in the 1950s and early 1960s.³¹

As the survey results from 1958 indicated, even the farmers who used bins continued to harvest ear corn. The move to shelled corn harvesting was a slow change. This middle way, using some new storage while continuing to use the old, was the only way that made sense to farmers who already had the structures for ear corn but wanted to realize the advantages of earlier harvesting. In the face of mounting corn harvests due to increasing yields, having some new storage was a hedge against wet conditions at harvest time. Arnold and Francis Krueger of Hardin County owned conventional cornercribs as well as a twenty-one foot diameter metal bin that would hold 4,400 bushels. Francis Krueger liked the idea of having storage for that much corn. "If all the rest of the corn is wet," he stated, "we know we can count on the corn in the new bin keeping." They could also harvest earlier and dry the grain in the bin, then move the dried corn into the overhead bins of the corn crib, saving a greater portion of the crop.³²

³¹ "Corn storage plans," *Wallaces Farmer*, 6 September 1958; Timely Tips, *Wallaces Farmer*, 3 June 1961.

³² Newt Hawkinson, "It pays to plan before you build grain storage," *Wallaces Farmer*, 19 August 1961.

Throughout the late 1950s and 1960s, more farmers erected grain bins. The 1958 poll indicated that a substantial majority of farmers were not considering any changes to their corn storage systems, but 12 percent of respondents' desired change. Of those who envisioned a new system, 43 percent wanted to install bins. The low cost of metal bins compared to other types of storage made them the most attractive method. Farmers modified older buildings and cribs to ease their storage needs, but the reality was that the yearly corn crop was increasing in size faster than farmers could modify old bins. An older crib that held 4,000 bushels of ear corn was fine for a farmer as long as yields were around fifty bushels per acre (approximately the average yield for the period from 1941 to 1949). Farmers could hold their entire crop from eighty acres in a conventional crib. But by the late 1950s yields varied from sixty-two to sixty-six bushels per acre, and in the early 1960s yields ranged from seventy-five to eighty bushels per acre. The same eighty acres of corn could now yield 6,400 bushels per acre, leaving the farmer 2,400 bushels short of storage space. Temporary cribs for ear corn were the least expensive option, but only for ear corn. The farmers who wanted new storage space needed bins to take advantage of combine harvesting.³³

Grain bins were the cheapest way to store shelled corn for farmers who wanted to get the most corn from the field and reduce labor costs. As indicated, the construction costs were among the least expensive for any new construction. An Iowa State University extension agricultural engineer noted that metal bins cost from \$.27 to \$.35 per bushel of capacity. But the costs to actually keep that corn in storage were the lowest, too. Any kind of stored corn is at risk from too much moisture, so getting and keeping the corn dry became an

³³ "Corn storage plans," *Wallaces Farmer*, 6 September 1958.

increasingly important issue as farmers began to harvest earlier and move away from harvesting ear corn.³⁴

The development that allowed farmers to harvest and store shelled corn was the crop dryer. Farmers who harvested corn at 25 to 30 percent moisture content needed to reduce the moisture to 13 percent to prevent it from rotting in storage. Getting corn dry was not such a problem when farmers harvested corn by hand over the course of weeks, even months. In the 1940s and early 1950s, farmers' desire to get corn out of fields infested by the European corn borer before ears dropped meant they were harvesting wet corn. Farmers who tried to store wet ear corn experimented with dryers to solve these problems. As soon as farmers used picker-shellors and combines to speed the harvest, drying corn became an absolute necessity. Ray Hayes of Crawford County summed up this viewpoint in 1958. "I picked [ear] corn early last year and dried it. I liked the results," he stated. "Now I'm looking forward to a picker-sheller." Drop dryers made it practical to harvest shelled corn because farmers could harvest early and dry the crop and reduce the risk of a wet corn crop spoiling in storage.³⁵

Farm journalists first discussed crop dryers in the late 1940s as farmers dealt with extremely moist ear corn at harvest time. In 1945 farmers experimented with placing ventilators in crops as well as forcing air through the stored corn. Farmers who used forced air used an oil burner and fan to push air into ventilators in cribs. On one Cherokee County farm, a dryer helped bring a load of 42 percent moisture corn down to 33 percent in two hours, which was promising news for farmers who risked losing a crop to mold. As long as farmers could get the corn to approximately 20 percent moisture by the time the crop froze it

³⁴ Hal Johnson, "Will you need more corn storage?," *Wallaces Farmer*, 7 September 1963; "What it costs to store corn," *Wallaces Farmer*, December 1967.

³⁵ "Put dry corn in your cribs," *Wallaces Farmer*, 20 September 1958.

would last until the spring thaw without spoiling. Most farmers, however, were not so fortunate. In the spring of 1946 much of that stored corn was still so wet that a writer for *Wallaces' Farmer* observed that "A lot of black and moldy corn is going to be offered to hogs" in forty counties in northern and central Iowa that year. An Agricultural Adjustment Administration survey of 1,000 corn cribs in that region indicated that almost half of corn was higher than twenty percent moisture, which meant that it was likely to spoil in the upcoming warmer weather.³⁶

There were few commercial drying units available in the 1940s, however, and little demand for what farmers called artificial drying. Dry conditions prevailed during the 1930s so there was little need to dry grain. Farmers who wanted to dry corn improvised by using a tractor to power a threshing machine fan to blow air through a canvas duct into the crib. Those who wanted heated air for drying enclosed the tractor engine with canvas to use the engine's heat to warm the forced air. These temporary expedients helped many farmers dry ear corn, while other farmers installed wire or wooden ventilators inside their cribs to allow for greater air circulation through the crop. Ventilators, however, reduced the amount of storage space for corn, forcing farmers to store more of their crop in temporary cribs.³⁷

Some farmers experienced success with drying ear corn in the late 1940s. In 1949 a serious infestation of corn borers combined with a strong wind storm in October snapped the brittle ear shanks of the corn, leaving as much as twenty bushels of corn per acre on the ground, out of reach of mechanical pickers. Farmers salvaged approximately 27 million

³⁶ "Wet Corn Stopped Husking Rush," *Wallaces Farmer*, 1 December 1945; "Drying Ear Corn by Mechanical Ventilation," United State Department of Agriculture, *Miscellaneous Publication No. 919*, (Washington, D.C.: U. S. Government Printing Office, 1963), 3; "Looks Like Moldy Corn for Hogs," *Wallaces Farmer*, 6 April 1946.

³⁷ "Engineers List Ways To Save Wet Corn," *Wallaces Farmer*, 2 August 1947; "Fix Cribs To Dry Corn," *Wallaces Farmer*, 15 September 1945.

bushels by gleaning fields by hand while livestock cleaned up approximately 45 million bushels. Farmers who had corn in the field suffered, but those who harvested early at high moisture content and then dried their corn managed to avoid some of the worst damage. Guy Coulter, a Grundy County landlord had his crop picked and in his crib for drying before the big wind of 1949. His renter's portion of the crop was still in the field during the storm, which cut the yield on the standing corn by 350 bushels.³⁸

The 1949 wind storm made a big impression on farmers who wanted to maximize yields. Denton Myers of Humboldt County considered purchasing a drying unit after the storm. In the 1950 season he planned to begin harvesting ear corn early at high moisture content and dry the corn in his cribs. As the fall progressed and the moisture content of the corn dropped, he would begin to field shell the crop and store shelled corn. Crop dryers helped farmers make the transition from ear corn harvesting and storage to shelled corn harvesting because they allowed farmers to have a degree of flexibility in harvesting that they did not previously have.³⁹

Throughout the 1950s, farmers boasted of the benefits of early picking and drying the crop with batch dryers. Just before picking season in 1954, a farmer warned that those who did not pick corn early were "likely to have trouble" with dropped ears because of severe European corn borer infestations. Walter Cramer of Wright County used a portable drying unit called a batch dryer to dry shelled corn before storing his grain. He was able to use his picker-sheller when his corn tested at 28 percent moisture, then dried up to 335 bushels of grain at a time in his batch dryer. Merrit Wassom of Sac County declared that his harvest

³⁸ "This Is The Year For Dryers," *Wallaces Farmer*, 7 October 1950; "What's Ahead In Corn Storage?," *Wallaces Farmer*, 2 August 1952; *Fiftieth Annual Iowa Year Book of Agriculture*, 1949, 15.

³⁹ "Tired of Docks on Corn?," *Wallaces Farmer*, 15 September 1951.

losses were so low after picking early and drying that “There wasn’t enough corn left in the field to keep a goose alive.” Some farmers believed that any costs associated with drying shelled corn in the fall were made up during the following year when farmers with ear corn paid to have their crop shelled. Warm weather in March and April of 1958 also convinced farmers that renting or purchasing a dryer was a necessity to save their stored crop from mold. As the temperature increased, corn that had been cribbed with high moisture would spoil.⁴⁰

The ability to dry shelled corn at harvest time was an incentive for farmers to use picker shellers and combines. In 1958 Ray Hayes of Crawford County claimed that after a year of drying ear corn he was “looking forward to a picker-sheller.” The 1959 harvest season was wet, which meant farmers couldn’t get into fields to harvest. Many farmers were left with corn in the fields that was too wet to harvest. Those who picked early had wet corn in cribs. Both situations were bad. “I decided early this fall to let my corn stand in the field until it was good and dry,” noted a farmer from Van Buren County. “Now I’m not so sure I did the right thing.” While many farmers continued to take their chances that the weather would be suitable for harvesting and storing ear corn, a minority of farmers harvested shelled corn and invested in dryers or rented them to minimize risk to the crop.⁴¹

Continuous flow dryers were even faster than the batch dryers. By 1960 farmers could use a portable dryer that continuously moved the grain in the dryer, drying faster than

⁴⁰ Dave Bryant, “Harvest corn early!,” *Wallaces Farmer*, 4 September 1954; “Use picker-sheller and dryer?,” *Wallaces Farmer*, 17 September 1955; “Put dry corn in your cribs,” *Wallaces Farmer*, 20 September 1958; “Stop wet corn spoilage losses,” *Wallaces Farmer*, 15 March 1958; “Emergency corn drying,” *Wallaces Farmer*, 5 April 1958. Farmers also received advice about drying from dryer manufacturers. See *Farmers’ Manual of Crop Drying*, (Agricultural Development Division of the Lennox Furnace Company, n.d.), Hull papers.

⁴¹ “Storage of Small Grains and Shelled Corn on the Farm,” United States Department of Agriculture, *Farmers’ Bulletin No. 2009* (Washington, D.C.: U. S. Government Printing Office, 1949); “Put dry corn in your cribs,” *Wallaces Farmer*, 20 September 1958. “This corn crop is a problem!,” *Wallaces Farmer*, 21 November 1959.

the batch dryer which simply held the corn in a chamber. Farmers added wet grain to the top which was dried by 180 degree to 220 degree air moving through the tunnels in the grain. Fans forced unheated air through the grain at the bottom of the dryer to cool it to a safe storage temperature. By moving the grain during the drying process, continuous flow dryers allowed farmers to add and remove grain during the drying period. This type of dryer was expensive and best suited to farmers who harvested large amounts of shelled corn, since they could keep the combines running without having to wait for a batch to be removed from the dryer. Experts suggested that farmers who harvested more than 30,000 bushels per year could best utilize this system. John Russell of Lee County, a farmer who used a bin dryer claimed, "With continuous flow, you could hardly buy the dryer alone for what I spent [on a bin and dryer]." ⁴²

Some farmers like Russell equipped grain bins with dryers instead of using portable machines. There were several options for farmers who used grain bins equipped with dryers. Farmers could simply use the grain bin as they would a batch dryer, loading from two to four feet of corn into the bin, running the dryer overnight, and then unloading the corn to be stored elsewhere. The batch was a relatively small quantity which meant drying was fast. This was known as batch-in-bin drying. Farmers could also dry corn and store it in the same bin one layer at a time. This was known as multiple-layer drying, and took much more time than batch-in-bin drying, although it required less handling. The first layer was

⁴² Timely Tips, *Wallaces Farmer*, 22 August 1970; Frank Holdmeyer, "Bin dryers...portable batch...continuous flow," *Wallaces Farmer*, 12 August 1971; "Boosting Profits with High-Moisture Corn," *Pioneer Corn Service Bulletin*, (n.d., circa 1965), 5, Hull papers; Norman West, "Match your dryer system to harvest rate," *Wallaces Farmer*, 28 August 1971.

approximately five feet deep. As soon as that layer was dry another four foot layer could be added. After three or four days, depending on moisture content, they added another layer.⁴³

Farmers could avoid the costs of purchasing drying equipment or incurring the costs of new storage buildings by hiring commercial dryers or storing their crop at grain elevators which provided drying service. The advantage to commercial storage was that farmers could use their time for tasks other than drying, such as fall tillage or fertilizer application. The grain elevator assumed the risk and management of the drying process. The major disadvantage to commercial storage was the fact that many elevators had limited storage space at harvest time, which put farmers at risk of having a wet crop with no storage.⁴⁴

The variety of new techniques, machines, and structures made grain storage and drying more complicated over the course of the 1960s. Just as farmers who dealt with herbicide and insecticide faced an ever more complicated array of products, combinations of products, and restrictions on the use of chemicals, farmers who used dryers found that corn drying also required careful management. They hoped to prevent problems of under drying and over drying. If farmers applied too much heat too quickly they risked cracking their grain, which allowed mold to grow and could ruin the crop. Corn that was to be sold in the fall only needed to be dried to 15 percent moisture while corn to be stored for a year needed to be 13 percent. Sometimes drying was uneven, which meant some of the corn might stay too moist and spoil.⁴⁵

⁴³ Samuel R. Aldrich and Earl R. Leng, *Modern Corn Production* (Cincinnati, Ohio: The Farm Quarterly, 1965), 280-283.

⁴⁴ "Boosting Profits with High-Moisture Corn," 3, Hull papers.

⁴⁵ Monte Sesker, "Tips for better dryer operation," *Wallaces Farmer*, 28 September 1968. A good example of the growing sophistication of grain storage and drying can be seen in *Planning Grain-Feed Handling for Livestock and Cash-Grain Farms, MWPS-13* (Ames, Iowa: Midwest Plan Service and Iowa State University, 1968), Records of the Midwest Plan Service.

Farmers worked on the problem of uneven moisture content in their new-style bins designed for drying. In 1962 Eugene Sukup of Franklin County bought his first grain bin to dry and store shelled corn. He was not satisfied with the results, however. Sukup found that pockets of grain did not dry properly and were ruined. He designed a system to break up those pockets of grain that were not drying properly with an old coal stoker auger from a furnace and mounted it in an electric drill. He suspended the drill and auger from a chain at the top of the bin and used it to drill into the grain, stirring it and breaking up any pockets that were too moist. Sukup filed for a patent and began to sell his “Easy Stir Auger” to implement dealers and farm equipment companies. Elmer Horstman of Hancock County also experimented with stirring devices in the mid 1960s. He used his bin as a batch dryer and stirred the corn during the drying process, cutting drying time by half and increasing the capacity from 1,000 bushels per batch to 2,400. Increasing drying speed meant decreasing costs. Without the stirring unit he spent \$.06 per bushel for electricity and fuel to dry the crop but with the stirring unit he reduced those expenses to under \$.04 per bushel. Horstman’s stirring unit allowed for uniform moisture content throughout the grain bin, achieving a goal shared by all farmers who used artificial drying and grain bins. Tests by Iowa State agricultural engineers confirmed that stirring was a fast and effective way to store the highest quality grain.⁴⁶

Farmers hoped that the increased production that they gained by harvesting shelled corn early and drying it rather than a late harvest of ear corn would pay for the increased costs of artificial drying. Cost figures ranged widely depending on the size of operation and

⁴⁶ Sukup advertisement, *Farm Industry News*, February 2003; “Stirring devices will speed grain drying,” *Wallaces Farmer*, 23 September 1967.

type of drying outfit farmers used, but drying became a regular part of the corn harvest for many farmers. Joseph Ludwig purchased a portable dryer in 1952 and used it in his crib for ear corn drying in 1952, 1953, and 1954, spending an average of \$121.86 per year for heating oil. He also used it on a custom basis, earning \$40 over the course of those three years. Ludwig did not dry corn again until 1958, although only on a limited basis. In 1965 Ludwig installed a crop dryer and LP fuel tank for his grain bin and used it every year up through 1970, spending an average of \$145.65 each year on fuel. Ludwig made the transition from drying corn on an intermittent basis to making it a regular part of his operation. These costs made up a big part of the total expense of raising a crop. In 1967 one Wright County farmer calculated that of the \$81.26 he spent to raise 150 bushels of corn on one acre, \$11.25 of that cost was drying, making it the second most expensive part of raising an acre of corn behind fertilizer. Combine harvesting accounted for 10 percent of the cost of raising an acre of corn, placing it as the third most expensive part of the operation.⁴⁷

Regardless of the method of drying and in spite of the expense, farmers did more of it during the 1960s. In 1964 farmers dried 86 percent of the corn crop in the crib without artificial drying. Only 13 percent of farmers used artificial drying on the farm while 1 percent had their crop dried commercially off the farm. By 1970 there were significant gains in artificial drying. Farmers used cribs and natural air drying for 57 percent of the corn crop and artificial drying on the farm for 41 percent of the crop with 2 percent of the crop dried off the farm. A growing number of farmers invested in crop drying equipment to use for custom work. Cyril Tiefenthaler of Carroll County invested \$80,000 in grain drying and

⁴⁷ Ludwig papers; Ken Hofmeyer, "What does it cost to grow good corn?," *Wallaces Farmer*, 23 September 1967.

storage facilities to handle his 50,000 bushels of corn and another 100,000 bushels for neighbors in 1969. Tiefenthaler explained that by using his equipment on a custom basis allowed him to make money and obtain the top quality equipment for himself and his two sons. Aggressive farmers such as this helped spread the practice of shelled corn harvesting and drying.⁴⁸

Foster and Madeline Mason's farm inventory from 1970 reveals the investment needed to conduct this new kind of harvest. The Mason family did not own a combine, but they did invest in corn drying and storage facilities over the course of the 1950s and 1960s. In addition to two wooden grain bins and three corn cribs constructed in the 1950s, the Masons owned two metal bins. They purchased both bins in the 1960s, and one of those was a 13,000 bushel Stormor model. The Stormor bin cost \$4,951 in 1965 and was the second only to a new John Deere tractor in terms of value on the inventory of machinery and buildings. The Masons owned several pieces of drying equipment, including a Butler manufactured dryer, two propane fuel tanks, and two devices to aid the process of drying corn in bins, a Stirway and Stirator. The value of these items as of January 27, 1971 was \$7,596, which was 17 percent of the total value of the Mason's inventory. When the value of the two tractors are removed from the inventory, which were the items used for multiple different farm tasks, the value of the drying facilities comprised 21 percent of the tools and implements, making it the most expensive equipment devoted to a single process on the farm.⁴⁹

⁴⁸ *Biennial Reports of Iowa Year Book of Agriculture, 1964-1965; 1966-1967; 1968-1969; 1970-1971*; Ralph Sanders and Richard Krumme, "How these farmers harvest and sell corn," *Successful Farming*, Harvesting Issue 1970.

⁴⁹ William Mason Family Farm Records, Foster and Madeline Mason, State Historical Society of Iowa, Des Moines.

Government programs helped farmers change their harvesting and storage practices, just as they were with pollution control measures and the transition to soybeans. Many farmers participated in the Commodity Credit Corporation (CCC) program that loaned farmers money to keep their crops on the farm until prices rose. The CCC, an agency of the USDA, allowed farmers the option of storing corn in bins or cribs at a low fee in exchange for government loans. A government inspector measured the storage area to determine storage capacity and then sealed the stored crop with a paper label across the door to prevent tampering. If prices advanced above the loan rate, farmers could sell their crop and keep the difference between the two prices. If prices failed to rise above the loan rate, farmers forfeited their crop to the US government and kept the loan payment. This program, first introduced in 1933, would help even out the problem of low prices at harvest time when supplies were generally ample and high prices at other times of the year when supplies were low.

But wet corn crops of the late 1940s posed problems for anyone who stored corn while increasing yields meant that storage needs outpaced capacity. Officials from the Production and Marketing Administration, the organization that replaced the AAA during the Truman administration, provided an incentive for farmers to reseal their corn in on-farm storage. They provided a payment of \$.13 per bushel for resealing corn in 1953, with \$.15 per bushel in 1955, figures that amounted to almost half the cost of constructing new grain bins. By the early 1950s, one fourth of all Iowa farmers wanted to build or buy new corn storage space, with another 7 percent willing to settle for temporary cribs. Those farmers

who planned to build new storage space had a special incentive to construct modern storage facilities that included grain dryers.⁵⁰

Government officials who were in charge of making CCC loans did not want farmers' crops to spoil in the crib or bin. If all or part of the crop spoiled the farmer would not be able to either repay the loan or would forfeit a damaged crop to the government. As early as 1949 the USDA began to make low-interest loans to individuals and groups of farmers who purchased grain dryers. The loans covered up to 75 percent of the delivered cost of the dryer. Terms were generous, with three year terms at 4 percent interest. Corn cribs for drying could be constructed with loans from the Agricultural Stabilization and Conservation Service, with the loan amount of up to 80 percent of the cost of construction. These programs continued into the 1960s. By 1965 construction loans for bins were available at 4 percent interest for five years, with a one year grace period before the loan was classified as delinquent. The government even sold surplus CCC owned grain bins to farmers. In 1965 the federal government prepared to auction 29 million bushels of storage capacity, providing many farmers the opportunity to obtain low cost bins. Rules for the 1967 and 1968 programs allowed individual farmers to borrow up to \$25,000 to construct storage and drying facilities, although for loans of over \$10,000 farmers needed to possess a real estate mortgage. Joseph Ludwig of Winneshiek County utilized this program to help him finance new bin construction in the late 1960s.⁵¹

⁵⁰ "Many Will Get New Cribs, Bins," *Wallaces Farmer*, 1 August 1953; "Need more corn storage," *Wallaces Farmer*, 6 August 1955.

⁵¹ "To Make Loans on Grain Dryers," *Wallaces Farmer*, 5 November 1949; "A Federal Loan Helped Build This," *Iowa Farm and Home Register*, 2 May 1954; "Government grain bins for sale," *Wallaces Farmer*, 6 February 1965; "Loans for bins and dryers," *Wallaces Farmer*, 26 August 1967; "Low cost loans for grain storage," *Wallaces Farmer*, 28 July 1968.

By 1969, the increasing number and capacity of grain bins and drying systems was testimony to the growing popularity of combine harvesting and new grain storage techniques. Bins as large as forty feet in diameter were under construction in the early 1960s, and there was no indication that the trend toward more and larger bins would be reversed. The Wiemers family operation located in Marshall County serves as an excellent comparison with the Levsen family farm discussed earlier. The Behlen Company featured both families in advertisements in the pages of *Wallaces Farmer* thirteen years apart. In the 1969 advertisement, the Wiemers' operation included at least seven storage bins, five of which dated to the mid 1960s and a batch dryer and dump pit for unloading added in 1967. In 1968 they added a continuous dryer with two large storage bins, giving them a total storage capacity of 57,000 bushels. The Levsen family, by contrast, had only 25,000 bushel capacity for their 700 acre farm in 1956. In 1969 Orval and Gene Wiemers had over twice as much corn storage space for their 1,000 acre farm. Increasing crop yields and the expansion of operations contributed to the need for more grain storage. While the storage needs for both families in the advertisements were different, the trend toward more and larger storage units to accommodate the increased yields and the larger scale of farming was clear in both advertisements.⁵²

Farmers who cultivated large acreages of corn could use a combine profitably, while those who harvested small acreages were best suited to ear corn harvest and storage. The combine could be used most profitably on farms with more than 8,000 bushels of corn plus additional acres in soybeans and possibly even small grains. Farmers such as Joseph

⁵² "More farmers use bins to dry corn," *Wallaces' Farmer*, 7 September 1963; Behlen Manufacturing Company advertisement, *Wallaces Farmer*, 26 April 1969.

Ludwig, who purchased combine in 1966 used his for his corn and soybeans and also did regular custom work in the late 1960s, spreading the cost of his investment over more acres. But a combine could only make sense to farmers who were willing to invest in a grain drying system. As the Fisher family of Hamilton County learned, replacing a two-row combine with four-row model could even make an old drying system obsolete. They used a batch dryer and several small bins as long as they harvested with the small combine, but when they bought the four-row model they invested in a large bin for layer drying. As one son explained, “the big bin gives us the extra capacity boost we need to get all our corn harvested in ample time.”⁵³

The prominence of combine harvesting machines by 1970 can be seen in efforts to commemorate corn harvests from the past. Just as Midwest Old Threshers’ Reunions in Mt. Pleasant became a way for farmers to relive steam and tractor-powered threshing in the 1950s after it was obsolete, farmers cooperated to remember older methods of corn harvesting and celebrate the change. A new open-air museum called Living History Farms, located on the edge of Des Moines, hosted its first corn harvest festival on October 24 and 25, 1970. The event featured demonstrations of hand corn husking, one and two-row mechanical pickers, a modern combine, and various models of hand-powered corn shellers. Farmers from central Iowa volunteered to operate the machines and discuss them with museum visitors. In addition to allowing farmers to reminisce about the old days, the museum assumed an educational mission “to show the younger set how it used to be done” and to “compare the best of yesterday’s methods with today’s mechanization.” With the

⁵³ Aldrich and Leng, *Modern Corn Production*, 280; Ludwig papers; Newt Hawkinson, “Which drying system for shelled corn?,” *Wallaces Farmer*, 15 August 1964.

passing of hand harvesting in the 1940s and the gradual displacement of ear corn harvesting with shelled corn harvesting in the 1960s, the retrospective event was appropriately timed. People who participated in harvesting changes appreciated the significance of the transition to more capital intensive farming. They also taught a younger generation that had little or no concept of the labor intensive work Carl Hamilton's generation experienced in hand harvesting.⁵⁴

Combines, drying equipment, and structures for shelled corn storage were much more expensive than pickers and cribs, but farmers used the combine on more acres by the early 1970s. The claims that promoters and farmers made for them were true. Farmers could harvest earlier to minimize losses in the field, a critical consideration when they spent increasing sums of money on the chemical cocktail of fertilizer, herbicide, and insecticide. They invested their labor and the cost of fuel, machinery, and seed to get their most important crop in the ground and helped the crop reach maturity by applying chemical fertilizer and pesticides. A growing number of farmers viewed high harvest costs as necessary to justify the other expenses of making a crop. They needed to reduce harvest losses, harvest early, and do so with the least amount of labor. Spending money was a technique to minimize risk. Combine harvesting and new storage and drying facilities made sense to farmers who wanted to maximize the return on their investment and continue farming into the 1970s.

⁵⁴ "Harvest show at History Farms," *Wallaces Farmer*, 24 October 1970; *Corn Harvest Festival*, 8mm, (Living History Farms Foundation and the Film Production Unit, Iowa State University, 1971), Special Collections, Parks Library, Iowa State University.

CONCLUSION

“It ain’t like the good ole days!”

Donald R. Murphy
Wallaces Farmer, February 10, 1968

When *Wallaces Farmer* editor Donald Murphy wrote this headline in 1968 he compared the current state of agriculture and rural life in Iowa with that of 1940, the year two sociologists published a study of Irwin, Iowa, a rural community in Shelby County. One of the most noticeable contrasts between 1940 and the late 1960s was the lack of people in the countryside. A long time farmer from Shelby County estimated that every other farmstead that formerly provided shelter and a livelihood for a family now stood empty. Vacant buildings were silent testimony to the fact that fewer people made a living off the same amount of land. Farmers who invested in new tools and techniques continued to farm, while those who either did not or could not make that investment left farming.¹

Farming was no longer like the good old days because farm families confronted a new set of circumstances during and after World War II. During the war Congress promised to support farm prices for at least two years after the cessation of hostilities. Congress maintained supported prices far beyond the two year period, however. Price supports plus wartime demand for commodities during World War II and the Korean War allowed farmers to invest in new equipment and buildings. In addition to improved commodity prices, farmers also faced a labor shortage. Wartime demands for servicemen and workers in defense industries helped reduce the supply of hired men who previously performed much of

¹ Donald R. Murphy, “It ain’t like the good ole days!,” *Wallaces Farmer*, 10 February 1968. For a more recent study of the Irwin community see Eric O. Hoiberg, “Irwin, Iowa: Persistence and Change in Shelby County,” in A. E. Luloff and R. S. Krannich, eds. *Persistence and Change in Rural Communities: A Fifty Year Follow-Up to Six Classics* (Wallingford, UK and New York: CABI Publishing, 2002).

the tedious work on farms in Iowa and the Corn Belt. Farmers turned to new equipment to meet the labor shortage. Beginning in the early 1950s farmers confronted a cost-price squeeze in which prices they paid increased faster than prices for farm commodities. While the squeeze eased in the late 1950s, the entire period up to 1972 was a time of decreasing returns per bushel of grain, gallon of milk, and pound of livestock. With lower per unit prices, farmers used technology to maximize production per acre and head of livestock. Faced with high labor costs and diminishing returns, farmers who hoped to remain in agriculture adopted new technology.²

Even though Extension professionals, experts at Iowa State, implement and chemical manufacturers, and farm journalists urged farmers to change, farmers were the ones who reshaped the landscape. There is a familiar old rural expression that you can lead a horse to water but cannot make it drink. A horse is independent enough to do what it will, sometimes in spite of what people want. The expression also applies to farmers and technology in the postwar period in Iowa, one of the leading agricultural states in the nation. Farmers consumed new technology because it was something that they believed they needed to do to continue farming. A noted historian labeled this period of technological change the “Second Agricultural Revolution,” but there would have been no revolution if no one had showed up. In this instance farmers were the revolutionaries. They were the people who actually transformed the land. Experts provided important information, but the people with grease under their fingernails and atrazine and crop oil on their overalls invested their time, money,

² For graphic representations of the postwar cost price squeeze, see Milton C. Hallberg, *Economic Trends in U.S. Agriculture and Food Systems Since World War II* (Ames: Iowa State University Press, 2001), 41-42.

and effort in new technology, even though no one could have foreseen all the ways in which changing technology would change the countryside.³

The changes in the land were remarkable to anyone who understood what farming was like in 1940. The use of farm chemicals such as fertilizer, herbicide, insecticide, and feed additives had significant implications for the Iowa landscape. This combination of chemicals allowed farmers to forgo the rotations that they learned from their parents. Since the late 1800s, crop rotations on many farms prevented the buildup of weed and insect species by changing up the environment every year or two. A field of corn would be given over to oats for a season. The oats were seeded with a hay crop, which would then produce for the next two years before returning to corn. This rotation also balanced the draw on the available supplies of nitrogen, phosphorous, and potassium. By 1970 it was no longer necessary to alternate crops of corn, oats, and hay on a given field. A few farmers even reversed the old logic of farming and used chemicals to support corn in the same field year after year, a practice called “continuous corn.” With pesticides and fertilizers, farmers were able to achieve dramatic increases in yields, fully realizing the potential of an earlier technology, hybrid corn. Corn and hay continued to be important crops on Iowa farms but oats faded in importance. Soybeans, boosted by chemical fertilizer, became Iowa’s second most important crop in terms of acreage. Farmers used pesticides to reduce pest populations of insects and weeds in fields, farmyards, and barns. Antibiotics and growth hormones in livestock feed allowed animals to reach market weight faster and with less feed as well as

³ Wayne D. Rasmussen, “The Impact of Technological Change on American Agriculture, 1862-1962,” *Journal of Economic History* 4 (December 1962): 578-591.

helping to prevent outbreaks of disease. The gains from all of these chemicals astounded farmers.

Machines were also important in transforming the land. While Murphy devoted most of his attention to the transition from horse power to tractor power, the full effect of those tractors was evident in the new machines they were designed to pull, notably combines and hay balers. As long as farmers simply modified older horse-drawn equipment for use with tractors and occasionally purchased a machine designed to be used with tractors, production remained limited. After World War II farmers used the power of the tractor's engine and supplementary engines to power machines designed for the tractor and to increase their productivity, especially in harvesting. Farmers made a rapid transition to pull-type combines since the new machines were often less expensive to operate than the existing technology. Hay balers, and to a lesser extent forage harvesters, became fixtures on Iowa farms where livestock production was a specialty. The combine harvester that could handle corn, small grain, and soybeans was even more expensive and impressive. In some cases, notably that of the combine with corn head, farmers resisted new technology. They preferred to use older corn pickers that matched their storage capacity on the farm rather than investing huge sums in new combines, buildings, and drying equipment.

While machines and chemicals allowed farmers to alter crop production patterns and land use, farm families changed the farmstead as much as they did the fields, pastures, and fencerows. They remodeled existing buildings to make room for larger corn crops and shelled corn storage as well as more intensive livestock farming. New dairy parlors replaced stanchion milking, while old horse stalls were broken up into spaces for hogs. The most ubiquitous new buildings were the metal grain bins for storing shelled corn. These buildings

were cheaper than corn cribs and suited to drying grain with forced heated air. Dairy farmers and cattle feeders installed new materials handling systems. They graded the land to make feedlots and built holding ponds to prevent waste from entering waterways. The most complex new buildings were the livestock confinement structures. These rectangular buildings with low pitched roofs included ventilation and automated feeding and watering systems were impressive examples of the application of industrial logic to agriculture. The manure pits under the confinement buildings and the manure lagoons were even more impressive examples of the industrial logic of waste and waste disposal.

With chemical fertilizer, herbicide, and insecticide, farmers grew ever larger crops of soybeans and corn from their acres. One of the biggest problems of this increased production was how to prepare corn for storage and where to store it. Many farmers remodeled older corn cribs and constructed new corn cribs, but more farmers used temporary storage or built the circular metal bins to hold the new bounty. These new and remodeled buildings reflected the role technology played in the everyday work of farm production.

Technological changes sometimes helped farmers. With chemical fertilizer, herbicide, and insecticide farmers grew ever larger crops of corn from their acres. Chemically laced feeds allowed farmers to produce livestock at lower cost. These production increases helped offset stagnant prices by allowing farmers to increase income by increasing production. Machines enabled farmers to reduce labor costs when dealing with their major crops of corn, small grains, soybeans, and hay. In the case of combining small grain and soybeans, the pull-type combine could actually be cheaper to purchase and use than the technology it replaced. Furthermore, farmers who substituted machines for human labor were dealing with tools and implements they understood. They were familiar with the

mechanical processes and principles involved in new machines because the old machines were similar to the new ones in many ways. Automated materials handling systems, the most complex machines, replaced the most labor, reducing the drudgery of hand milking and shortening the long round of daily livestock feeding. Farmers increased production per acre and per animal, which helped offset shrinking per unit costs.

As much as farmers enjoyed many benefits of the new technology in terms of increased production and labor savings, they also contended with several problems that occupied a growing share of their time, effort, and money. One of the dilemmas they faced was that the pesticides they used to increase production by limiting populations of competing species allowed other species to thrive. Farmers reduced the threat of broadleaf weeds only to find that grassy weed species that were resistant to chemicals filled the void. Similarly, new insect species thrived when farmers used insecticide controlled targeted species. The western corn rootworm moved into Iowa as populations of northern corn rootworms declined. Livestock pests such as numerous fly species developed resistance to certain chemicals when some offspring survived and reproduced with other surviving offspring. The new chemicals that killed resistant species were much more toxic to humans and animals, increasing the dangers of a risky job. By the 1960s farmers applied more fertilizer per acre to maximize yields and new kinds of herbicide and in new combinations. Livestock manure was a problem for farmers who concentrated larger herds in feedlots and confinement buildings. Antibiotics appeared to lose some of their growth enhancing properties during the 1960s, just as pesticides lost some potency. Farmers frequently responded by using more chemicals, new formulations, and, in some cases, using cultural, biological or mechanical control techniques.

The ways in which farmers used new technology sometimes brought criticism from other farmers, the public, and government agencies and officials. Experts and manufacturers introduced some chemical technology such as insecticides and growth hormones with severe warnings about the toxicity of these chemicals and admonitions to use with care, while other chemicals such as fertilizer and herbicide seemed benign. It was only after highly publicized incidents involving urban, suburban, and rural pollution problems that Americans became concerned about the consequences of technology use. After years of use, however, problems became apparent to farmers and many others. Concerns about misuse of chemicals brought unwanted publicity and increasing regulation. Iowa state law required commercial pesticide applicators to be trained and regulated livestock feedlots of specified sizes through a system of permits to minimize runoff problems. The federal government banned DDT and restricted the use of DES to implants. Many farmers believed that they were besieged by outsiders who did not understand agriculture or chemicals. As one journalist noted, farmers were in a “fight for survival.”⁴

Still, not all farmers believed that they were beyond reproach. Sixty-nine percent of Iowa farmers surveyed in 1971 believed that pollution was not yet a serious problem but that measures for prevention were necessary, while 20 percent believed that pollution was a serious problem and a vigorous control program was needed. But in the 1970s farmers would no longer be able to use their property exactly as they wanted. Farmers had to consider the effects of the way they conducted their business because it was the law. The days of untrammelled property rights were over. The fact that there was any government

⁴ For a concise overview of the environmental movement in the United States see Rothman, *Saving the Planet*. Fred Bailey, Jr., “From DES to Fertilizer---We’re In a Fight for Survival,” *Successful Farming*, May 1972.

regulation of technology use at all would have surprised farmers of the 1940s who generally considered government in its relation to agriculture in terms of commodity programs and prices, tariffs, and soil conservation.⁵

Farmers of the 1940s also would have been surprised by the increasing costs of the new technology that became essential on Iowa farms by the early 1970s. Every farmer lived with the financial consequences of replacing human labor with machines and chemicals and using chemicals to maximize production. Figured in constant 1950 dollars, farmers' labor costs fell by over half between 1950 and 1970. At the same time, other expenses increased. Farmers increased expenses for power and machinery costs by 30 percent and more than tripled fertilizer expenses. Farmers who wanted to stay in agriculture paid these new higher costs as a part of doing business. They found that paying capital expenses for machinery was preferable to paying increasing labor costs. Chemical costs were low in the 1940s and 1950s, but steadily increased in the 1960s. Farmers planned on paying for tillage, seed, planting, cultivating, and harvesting, so it made sense to use chemicals to get the largest crop possible out of the investment they already planned to make. Similarly, it was important to reduce labor costs by using new machines.⁶

Farmers who purchased chemicals and new machines such as combines adapted for corn, soybeans, and small grains found it beneficial to spread the large investments they

⁵ Al Bull, "What kind of Iowa do we want?" *Wallaces Farmer*, 13 November 1971. In a study of Iowa farmers from the mid 1970s, a rural sociologist found that approximately 40 percent of farmers were satisfied with current government regulation of agricultural chemicals and pollution control measures, while from 10 to 14 percent of farmers believed there was too little regulation. The poll, however, only addressed the issue of regulation, not the technology that helped create the sense among rural and urban people that regulation was necessary. Farmers accepted the chemicals and machines as essential to farming. They did not question the value of new technology or believe that it was bad; it was only potential abuses and abusers of technology that were to be regulated. Eric O. Hoiberg and Wallace Huffman, *Profile of Iowa Farms and Farm Families: 1976*, Iowa Agriculture and Home Economics Experiment Station and Cooperative Extension Service, Iowa State University, Ames, Iowa, *Bulletin P-141*, April 1978, 14-15.

⁶ "Big rise in farm costs shown in USDA study," *Wallaces Farmer*, February 26, 1972.

made in technology over more acres. In some cases, they did this by performing custom work for other farmers who did not own combines. Custom work was a good solution for farmers who purchased hay balers, sprayers and combines to recover some of their investment faster than if they simply used the machines themselves. It was also a way of obtaining labor saving machinery that might not otherwise be profitable to use on a small farm. Many farmers preferred to expand operations by purchasing or renting land to get the benefits of their technology investment rather than doing custom work. A study of Iowa farm records from 1968 indicated that those who farmed more than 500 acres paid much less in operating cost than smaller farms. The biggest savings was for machinery and fuel. People who farmed 160 acres paid \$32 per acre for machinery, power, and fuel, while those who farmed 320 acres paid \$25 per acre. Those costs totaled \$19 per acre for 600 acre farms. The difference in overall cost per acre was even more remarkable. The farm family with 160 acres paid \$107 per acre in operating expenses and labor while the farmer with 600 acres paid only \$64 per acre. Farmers who committed to the latest technology were leaders in the farm expansion movement of the postwar period.⁷

As farm families left agriculture for retirement or to find other ways of making a living, the land they left behind stayed in production. With fewer farmers, there was more land per farm, especially after 1950 when the rate of migration from farm to town became more rapid. The size of the average Iowa farm in 1945 was approximately 169 acres, but by 1970 the average farm was 249 acres. Farmers who owned all the land they farmed only increased the size of their landholdings a little, however. The demand for land was high and so were prices, making it difficult to increase farm size through purchase. The most common

⁷ Dick Hanson, "It Costs Less To Farm Big," *Successful Farming*, March 1970.

response for farmers was to rent more land rather than purchase it. The strategy of part-ownership allowed farmers to use their new equipment to increase the scale of operations without going into debt for land. Farm families who were part-owners increased the size of operations from 205 acres in 1949 to over 300 acres in 1970. The proportion of farmland farmed by part-owners in Iowa and the other Corn Belt states of Illinois, Indiana, and Ohio increased from under 20 percent in 1940 to approximately 45 percent in 1970. During the same period the proportion of land farmed by full owners declined from approximately half of land in farms to less than 40 percent. Expansion was here to stay.⁸

In the 1970s and beyond the trends of farm expansion, high land prices, increasing indebtedness, and larger machinery were even more pronounced. Iowa farmers realized the industrial ideal in American agriculture, although that was not necessarily what they intended to do. Industrial techniques of efficiency and the substitution of capital for labor were conservative strategies. The farmers discussed in the previous pages hoped to stay in agriculture for many reasons, but their goal was to keep producing and to make a decent living for their families.

Who made the difference? Farmers were the most important people in transforming the work of agriculture and the land. They received advice, information, and encouragement from many sources. One of the most prominent of these was the Cooperative Extension Service. With a network of County Directors and experts based in Ames and at regional offices, Extension leaders were in a unique position to influence farmers. Farmers read articles in magazines and newspapers about their peers who used new techniques and the

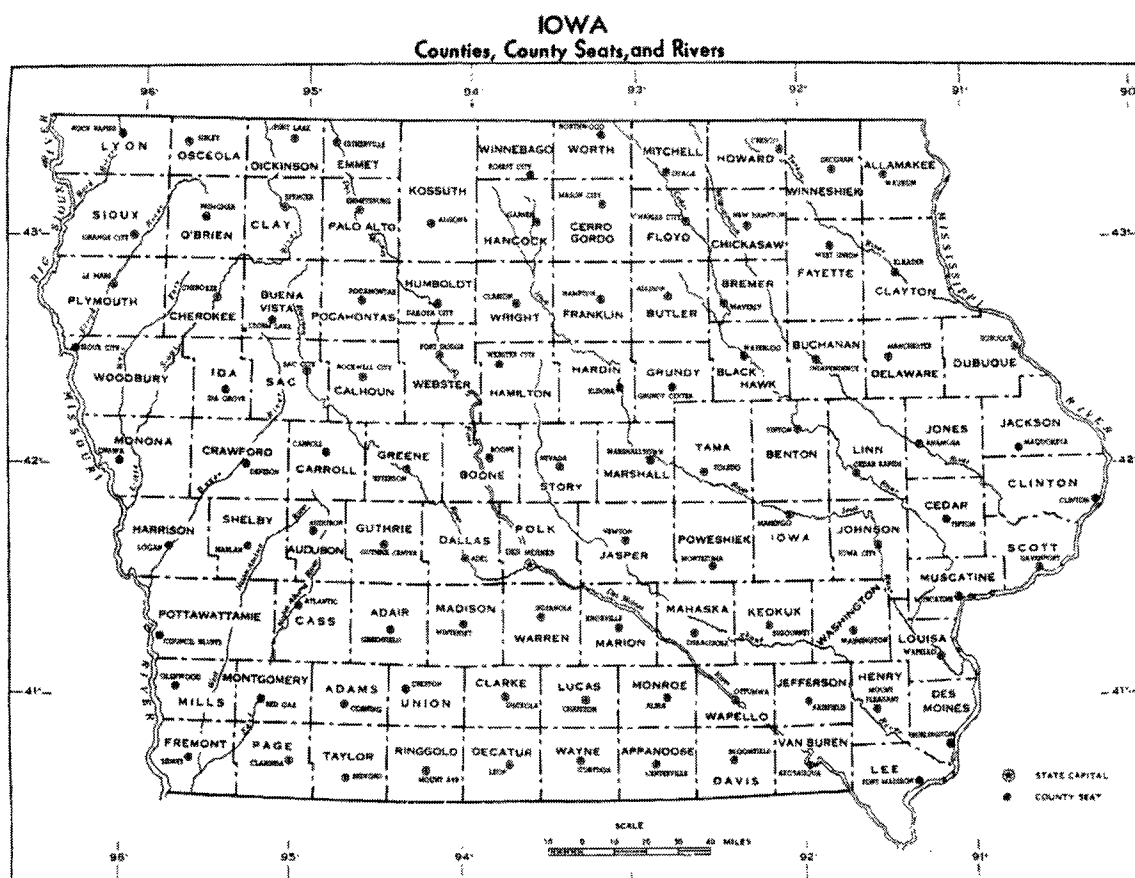
⁸ This trend toward part ownership is discussed more fully in John Fraser Hart, "Part-Ownership and Farm Enlargement in the Midwest," *Annals of the Association of American Geographers*, 81 (March 1991): 67-70.

degree of success those people experienced. Manufacturers and advertisers reached out to tell farmers about extraordinary gains and profits they would realize with new technology. Government policies that supported prices and encouraged farmers to take land out of cultivation put pressure on farmers to increase profits on land that was in production. But for all these voices and pressures urging farmers to change, none of them could make farmers change their behavior. Instead, Iowa farmers made the decisions, for better and worse, that contributed to the industrialization of the rural landscape.

Vacant houses were not the only symbols of the depopulation wrought in part by the farmers who industrialized Iowa's farms. There were other new markers of change in the landscape. The new grain bins equipped with crop dryers, the combines, balers, and forage harvesters parked in sheds and barns were also tools of farm expansion. Automated feeding systems, new dairy parlors, feedlots, pole barns, and confinement feeding operations enabled a handful of farmers to do what many hands had previously done. Corn, soybeans, and hay were now the most important crops, while farmers relegated oats and other small grains to a smaller percentage of Iowa acres. Fields of thickly planted corn and soybeans were the rule, not the exception, after the rise of fertilizer and pesticides became common. The sprayers, containers of herbicide, and bags of purchased fertilizer and feed were evidence of the chemicals that allowed farmers to increase yields per acre and production per animal. By the 1970s new weed and insect species which were previously unknown or of minor importance on Iowa farms in 1940 now inhabited fields, fencerows, and farmyards thanks to the technology that farmers used. These physical manifestations of technological change in the landscape were signs that Iowa, the heart of the Corn Belt, was a very different place in 1972 than it had been in 1945, even as it remained a place dedicated to agriculture.

APPENDIX A.

Map of Iowa



Map of Iowa, 1950. *U.S. Census of Agriculture: 1950*, volume 1, part 9. Washington, D.C.: U. S. Government Printing Office, 1952.

APPENDIX B.

Tables

Table 1. Number of Farms in Iowa and Average Farm Size by Acres, 1945-1970.

Year	Number of Farms	Average Acres per Farm
1945	205,399	169
1950	200,401	173
1955	192,028	181
1960	180,595	192
1965	153,699	223
1970	135,264	249

Source: *Iowa Yearbook of Agriculture*, 1945-1971.

Table 2. Selected Crop Acreages, 1945-1970.

Year	Corn for Grain	Corn for Other Purposes, including Silage	Oats for Grain	Hay	Soybeans	Pasture	Total Harvested Acres
1945	9,852,516	778,041	5,226,739	3,107,779	1,883,619	10,283,877	21,502,062
1950	9,352,747	339,724	6,429,658	3,662,136	1,891,775	9,730,331	22,325,951
1955	10,225,431	433,660	5,734,027	3,960,708	2,228,609	9,199,542	22,874,433
1960	12,090,676	394,393	4,045,230	3,498,343	2,564,171	8,159,989	22,894,477
1965	9,871,496	486,086	1,970,809	3,005,769	4,755,709	7,753,448	20,294,040
1970	10,004,162	507,106	1,657,616	2,451,241	5,618,268	7,255,556	20,427,916

Source: *Iowa Yearbook of Agriculture*, 1945-1971.

Table 3. Selected Field Equipment on Iowa Farms, 1945-1970.

Year	Tractor Drawn Combines	Corn Pickers	Pick-Up Hay Balers	Forage Harvesters
1945	20,918	39,137	3,215	-
1950	44,282	81,017	10,221	-
1955	76,672	105,074	36,442	-
1960	90,027	103,557	46,469	12,916
1965	78,625	89,568	51,799	13,788
1970	54,147	68,131	49,006	14,895

Source: *Iowa Yearbook of Agriculture*, 1945-1971.

Table 4. Percent of Iowa Farms with Selected Machines, 1945-1970.

Year	Tractor Drawn Combines	Corn Pickers	Pick-Up Hay Balers	Forage Harvesters
1945	10	19	2	-
1950	22	40	5	-
1955	40	55	19	-
1960	50	57	26	7
1965	51	58	34	9
1970	40	50	36	11

Source: *Iowa Yearbook of Agriculture*, 1945-1971.

Table 5.

Percent of Corn Crop Harvested, Dried, and Stored by Method, 1964-1970.

Year	Harvest				Drying			Storage		
	Mechanical Picker	Picker- Sheller	Combine with Corn Head	Hand Pick	Natural Air Dry	Artificial Dry On Farm	Artificial Dry Off Farm	Cribs, Bins & Piles	Silos	Off Farm
1964	81.6	6.0	12.7	.1	86.2	12.5	1.3	87.6	2.6	-
1965	75.2	5.8	18.9	.1	83.3	15.7	1.1	86.9	2.7	-
1966	66.2	6.8	26.9	.1	77.4	21.4	1.2	81.2	3.1	7.0
1967	60.5	7.7	31.5	.3	68.5	28.2	3.3	80.5	2.8	9.7
1968	56.6	7.9	34.6	.9	68.1	26.8	5.1	78.1	3.8	6.8
1969	51.1	8.3	40.5	.1	61.5	35.1	3.4	74.1	4.4	8.0
1970	45.8	8.4	45.6	.2	57.0	40.6	2.4	74.3	4.8	7.8

Source: *Iowa Yearbook of Agriculture*, 1964-1971.

Table 6. Commercial Fertilizer Used on Iowa Farms, 1945-1970.

<u>Year</u>	<u>Total Tons Used</u>
1945	n/a
1950	283,000
1955	507,697
1960	585,730
1965	1,045,172
1970	n/a

Source: *Iowa Yearbook of Agriculture*, 1945-1971.

Table 7. Soil Insecticide Use on Iowa Corn Acres, 1953-1959.

<u>Year</u>	<u>Corn Acres Treated with Soil Insecticide for Soil Insects</u>	<u>Treated Acres as Percent of Number of Corn Acres Harvested for Grain</u>
1953	85,000	0.8
1954	240,000	2.4
1955	1,244,000	12.0
1956	1,030,000	13.0
1957	1,685,000	17.0
1958	2,194,000	23.0
1959	3,192,000	27.0

Source: *Iowa Yearbook of Agriculture*, 1953-1959.

APPENDIX C.

Illustrations

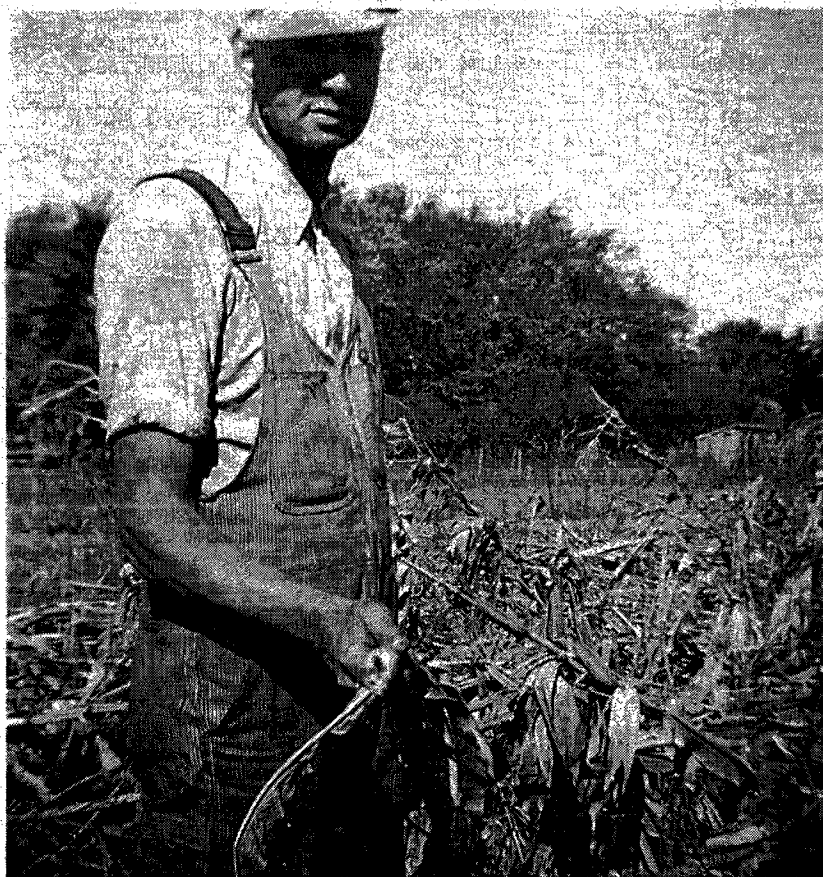


Figure 1. The broken stalks in this corn field indicate the extent of damage due to European corn borer infestation in 1948. Photo taken by Harold Sherma, Bristow, Iowa. *Annual Report, Entomology*, 1948. Special Collections, Parks Library, Iowa State University.

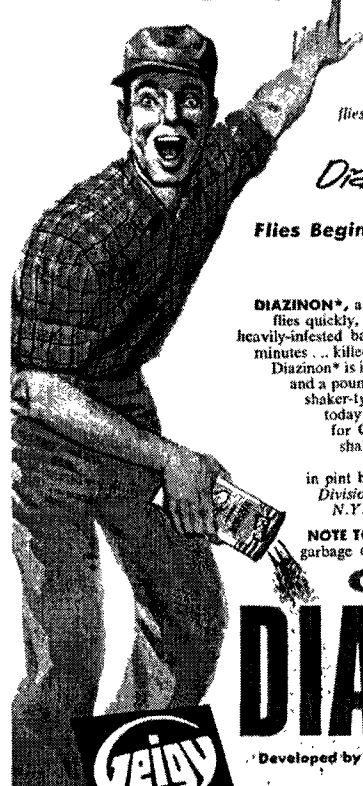


Figure 2. More European corn borer damage in Butler County. Photo taken by Harold Sherma, Bristow, Iowa. *Annual Report, Entomology*, 1948. Special Collections, Parks Library, Iowa State University.



Figure 3. The photo caption is "Dusting for Corn Borer Control." In the late 1940s and early 1950s farmers used DDT for mid-season rescue operations like this. By the late 1950s, however, they relied less on DDT and more on selecting varieties of borer-resistant hybrid corn. *Annual Report, Entomology*, 1948. Special Collections, Parks Library, Iowa State University.

MORE BEEF, PORK, EGGS IF YOU GET RID OF FLIES



ACTUAL TESTS conducted at Iowa State College and other state experiment stations show that beef cattle make the same gains with 20% less feed — *when you get rid of flies!* Hogs gain faster, hens lay better — *when you get rid of flies!*

Diazinon Kills Resistant Flies!

Flies Begin to Die in 10 Minutes!

97% Are Killed within 4 Hours!

DIAZINON*, a new development by the originators of DDT insecticides, kills flies quickly, surely — even the most resistant strains! In practical tests in heavily-infested barns and poultry houses, Diazinon* began to kill flies in 10 minutes ... killed 97% in 4 hours ... continued to work for as long as 8 weeks!

Diazinon* is inexpensive — enough to treat the average barn costs about 25¢, and a pound will protect an entire farm! Easy to use — just sprinkle from shaker-type canister on floors or litter. Get Geigy Diazinon* Fly Killer today from your local store, elevator, hatchery or feed dealer. Ask for Geigy Diazinon* Fly Killer, the ready-to-use dry bait in 1 lb. shaker-type canisters and 5 lb. bags, or Geigy Liquid Diazinon*

Fly Killer, an emulsion concentrate for use in sprays, available in pint bottles and gallon cans. **GEIGY AGRICULTURAL CHEMICALS**, Division of Geigy Chemical Corporation, 89 Barclay St., New York 8, N.Y. Branches at Des Moines, Ia., Fresno, Calif. and Leland, Miss.

NOTE TO WIVES: Sprinkle Geigy Diazinon* Fly Killer in and around garbage cans and on litter in poultry house — watch flies disappear!

GEIGY DIAZINON*

Developed by the Originators of DDT Insecticides



Try These Other Geigy Products



GEIGY ROSE DUST
Protects against Japanese beetles, thrips, aphids, white black spot, powdery mildew, others.



GEIGY MULTI-PURPOSE FRUIT SPRAY protects apples, peaches, pears, grapes and cherries against most insect diseases.



GEIGY GARDEN DUST protects tomatoes, beans, cucumbers, melons, squash, cabbage, potatoes, against most insect diseases.



SEQUESTRENE WAFER** contains 15% iron as iron chelate in vegetable, fruits, shrubs, trees and flowers.

Figure 4. Farmers liked DDT and other chlorinated hydrocarbon insecticides for fly control but learned that some flies developed resistance to those chemicals. They turned to other varieties such as diazinon, an organophosphate insecticide, to obtain chemical control of fly species to increase milk and beef production. *Successful Farming*, May 1955.

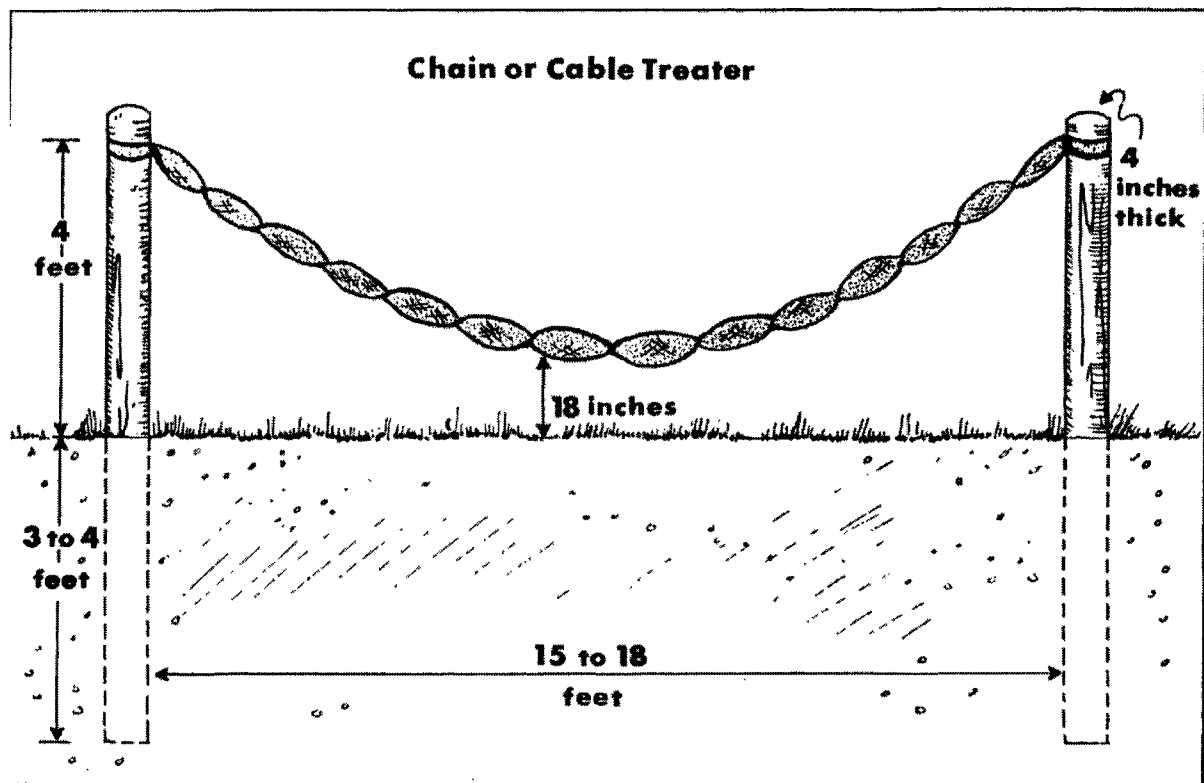
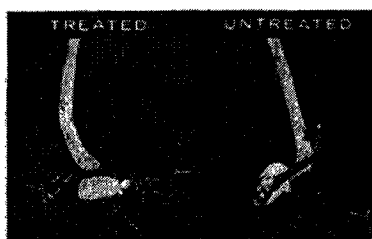


Figure 5. Farmers installed chain or cable treaters for fly horn fly control in their pastures or feed lots. The chain or cable was wrapped in burlap that was soaked in DDT for beef cattle or methoxychlor for dairy cattle. "Flies on Livestock," Agricultural Extension Service, Iowa State College, Ames, Iowa, *Pamphlet 200*, May 1953.

More Corn!



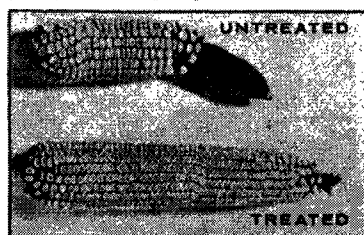
IT STARTS WITH THE SEED Good germination is the start of a good corn crop. Heptachlor protects seed from wire-worms, seed corn maggots, beetles, and other insects.



SAFE SEEDLINGS Heptachlor will protect seedlings from cutworm damage, and from root-feeding insects. Stand losses are greatly reduced by Heptachlor treatment.



STRONG ROOTS When corn rootworms, white grubs, grape colaspis larvae and other insects feed on corn roots, they cut yields two ways. First, nutrient and moisture uptake are reduced, limiting ear development. Second, infested plants lose their holding power, and go down easily in wind or rain, and this increases picking losses.



FULL EARS Corn with damaged roots produces smaller ears. And adult corn rootworm beetles may eat silks, limiting pollination. If your stand is 14,000 per acre, 1 ounce less weight per ear will cost you 12 bushels of corn per acre! Heptachlor prevents this loss. For complete information, write *Velsicol Chemical Corporation, 341 East Ohio Street, Chicago, Illinois 60611*

Kill soil insects with Heptachlor

ASK FOR HEPTACHLOR AT YOUR DEALER'S TODAY!

20% Granules • Emulsifiable Concentrates • Liquid and Dry Fertilizer Mixtures



SEED TREATERS...
Just mix with seed in planter
box to give germinating
corn extra protection!

**MAIL COUPON
TODAY FOR FREE
SOIL INSECT
BOOKLET!**

Velsicol Chemical Corporation
341 East Ohio Street, Chicago, Illinois 60611

WF-345

Gentlemen: Please send me your free educational booklet,
"Soil Insect Control in Corn."

Name

Rm:

Time Date

WALLACE FARMER

Figure 6. Soil insects such as corn rootworms preyed on corn plants. Farmers applied insecticide at planting time to maximize yields. *Wallaces Farmer*, 6 March 1965.

Black indicates area where western corn rootworm has become resistant to aldrin and heptachlor. Resistant strains may be present in screened area but no checks were made. Large dots represent isolated cases where northern species were found to be resistant.

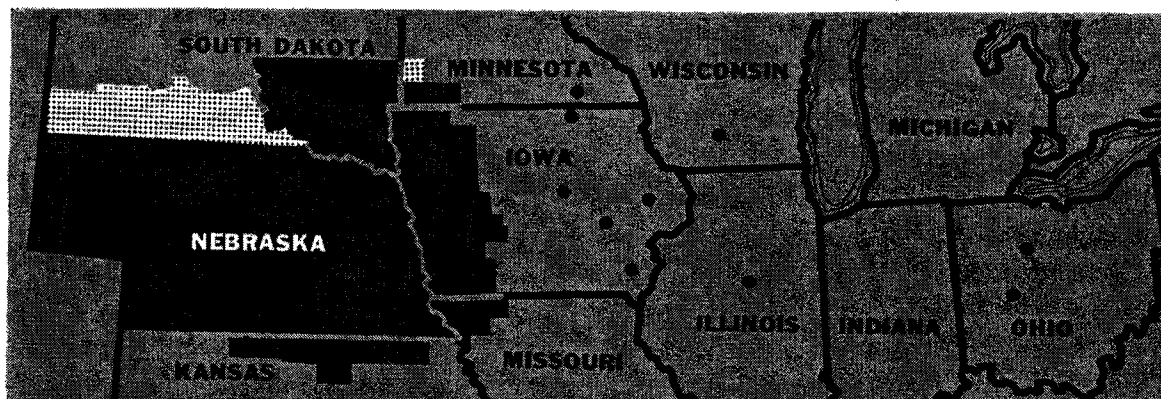


Figure 7. By 1964 the Western corn rootworm moved into Iowa. As farmers reduced populations of Northern corn rootworms, a resistant species moved in and proliferated. *Successful Farming*, January 1964.



Figure 8. Spraying herbicide such as 2,4-D along fence lines at the edges of fields was an important part of the war on weeds. Weeds that spread into cropland and pastures through rhizomes or dispersing seeds cut crop yields. This photo from July, 1950 is of Orville Wilson from Dallas County, although the editors of *Wallaces Farmer* used the image in the 16 June 1951, issue.



Figure 9. When 2,4-D was new farmers used it on weedy parts of their fields or only when wet conditions kept them out of the field. In the 1960s farmers often used herbicide on a greater percentage of their acres. In some cases they used herbicide to reduce the number of times they cultivated corn. This photo of Bernard Derner of Dickinson County is titled "Spray vs. Weeds." Derner used dropped nozzles suspended from the spray boom to get the chemical onto weeds below the corn leaves. *Wallaces Farmer*, 10 July 1963.

AITA—UAMI PRODUCE
 Arthur—Wunchell Service
 Atkins—Atkins Grain Company
 Atlantic—Malones Seed Co.
 Bondurant—Farmers Elevator Co.
 Vonstein Spray Service
 Brooklyn—Carpenters Feed Store
 Buffalo Center—Loren Aukes
 Calumet—Priegnitz Hardware
 Carpenter—Carpenter Produce
 Charles City—Sar Seed Farms
 Charlotte—Hill Feed & Farm Supply
 Cherokee—J & L Implement Co.
 Coon Rapids—Hague Hatchery
 Dana—Juhl Feed Store
 Davenport—Twin State Eng. &
 Chem. Co.
 Dexter—Morford & Scott
 Fertilizer Service
 Diagonal—Schlapa Inc.
 Durant—Durant Elevator Co.
 Dyersville—Farmers Union Co-op
 Elberon—Gardner & Delf
 Eldora—Barnard Implement Co.
 Fairfax—Fairfax Grain Company
 Fairfield—Condon Grain & Feed
 Fort Dodge—Farmers Co-op Grain
 & Coal Co.
 Galva—K & H Implement Co.
 Germantown—Miller's Store
 Gilbert—Crop Care Company
 Granville—Beck's Produce
 Green Mountain—Farmers Elevator
 Co. Inc.
 Grinnell—Agricultural Service
 Grundy Center—George Beenen
 & Son
 Havelock—McCoulough Oil
 Company
 Houghton—Houghton Elevator
 Hudson—Strayer Seed Farms
 Ida Grove—Miller's 86 Service
 Independence—Roy's Feed & Seed
 Iowa City—Ken's Auto & Farm
 Supply
 Jefferson—Monthei Bros.
 Keota—Keota Spray Service
 Tadlock & Osweiler,
 Spray Division Inc.
 Knoxville—Marion Co. Produce
 Larrabee—Don James
 Leighton—DeJong Seed Company
 Lenox—Barrans Farm Supply
 Linn Grove—Lyster Oil Co.
 Lost Nation—Lost Nation Mill
 Low Moor—Low Moor Feed Service
 Mallard—Mallard Produce
 Maquoketa—B & Z Mill & Feed Inc.
 Mike's Feed Service
 Marshalltown—Carlson Agricul-
 tural Service
 Frank's Farm
 Supply
 Mason City—Farmers Feed & Grain
 Mason City
 Warehouse
 Mechanicsville—Williams Feed
 Service

are choking out your corn, you can Midland, Michigan 48640.

ANNOUNCING: The exciting old way to wipe out foxtail.



Mediapolis—Kline Hardware
 Miles—Feeders Supply
 Montezuma—Audas Supply
 Company
 Ronald Reams
 Monticello—Eggers Feed Service
 Montrose—Montrose Elevator
 Mount Pleasant—Petersons, Inc.
 Mount Union—Mount Union
 Elevator
 Newton—Newton Seed Store
 Snook Bros. Produce
 Northwood—Harris Farm Service
 & Supply
 Olin—Lekrman Equipment
 Olin Elevator
 Packwood—A. D. Hayes Company
 Peterson—Tad's Shop
 Pleasantville—Farm & Town
 Industries Inc.

Pocahontas—Barrett Milling &
 Feeds
 Primghar—Nagle's Farm Store
 Richland—Hoskins Farm Supply
 Rock Falls—Don's Cash Store
 Rossie—Anderson Elevator
 Rowley—Kaesser Implement
 Ruthven—Miller's Truck Service
 Schaller—Dale Swanson
 Scranton—Elhwanger Grain & Feed
 Sigourney—Wayne Feed Supply Co.
 Sioux Rapids—George's Drug
 Sperry—Sperry Union Store
 Spirit Lake—Farmers Elevator Co.
 Stanwood—Jack's Feed &
 Fertilizer
 Stockport—Allen Cortor
 Swisher—Swisher Farm Supply

Thornton—Farmers Co-op Company
 Traer—Cas Feed Store
 Urbana—Bendull & McCaleb
 Villisca—Danielson Implement
 Company
 Vinton—Bendull & Sons
 Walcott—Bernard Frye
 Walford—Pollock Elevators
 Walker—F. J. Krob & Son
 Wapello—Farmers Elevator &
 Exchange
 Washington—Don Sheetz
 Waukee—Baer Ag. Supply
 Wellman—Homer Vincent
 Welton—Welton Elevator
 West Branch—Farmers Feed &
 Produce
 Wyoming—Big Bill's Feed Inc.

Figure 10. Grassy weeds such as giant foxtail, pictured here, became more common as farmers used 2,4-D to reduce populations of broad leaf weeds. Farmers used new chemicals, combinations of chemicals, and application techniques to fight grassy weeds that filled the ecological vacuum. *Wallaces Farmer*, 27 May 1967.



Figure 11. In the mid 1960s almost all Iowa farmers used herbicide on a portion of their acres. As cartoonist Hank Warner suggested, knowledge of herbicide was essential to becoming a farmer in the postwar Corn Belt. *Wallaces Farmer*, 5 June 1965.



Figure 12. In this undated photograph 0-20-20 fertilizer is spread on oat stubble on the Russell Gould farm in Worth County. *Wallaces Farmer*.



Figure 13. Applying side-dressing fertilizer on a Cherokee County corn field on 28 June 1949. The owner of this farm reported that he did not use fertilizer on his bottomland, only on his upland corn fields. *Wallaces Farmer*, 17 June 1950.



Figure 14. Farmers boosted yields by using anhydrous ammonia, a gaseous form of nitrogen that was 82.2 percent nitrogen. Injecting the gas into the ground allowed the gas to bond with soil particles. Charlie Knudsen of Audubon County is pictured here, applying nitrogen to young corn in June, 1951. Knudsen reported that in 1951 he would use his applicator on sixty-five of his own corn acres and 1,600 acres for other farmers on a custom basis. *Wallaces Farmer*, 2 May 1953.

Year 1961

(Soil Productivity)

CROP AND SOIL MANAGEMENT RECORD

Form F14

Name Joe Ludwig

Address Ft. Atkinson

County Winnebago

Township Lumsden

Section 22

NORTH

EAST

SOUTH

Field A 20.1 A
Corn yield 85 bu
120 # of 5-21-20
150 # of 33 Nitrogen

Field B 20.1 A
Corn 22.3 acres
120 # of 5-21-20
120 # of 33 Nitrogen
fertilizer 170 lbs
yield 11 bu

Field C 35.0 A
Hay yield 3 1/2 tons

Field D 10.6 A
135 # of 5-20-20
yield 80 bu

Field E 8.7 A
Oats (cl)
yield 27 bu

Field F 10.1 A
140 # of 5-20-20
120 # of 33 Nitrogen
yield 85 bu

Field G 4.4 A

Field H 11.1 A
Oats
yield 2.15 tons
20 A Hay

Field I 8.1 A
Oats
yield 27 bu

Field J 10.1 A
Oats
yield 27 bu

Field K 10.1 A
Oats
yield 27 bu

Field L 10.1 A
Oats
yield 27 bu

Field M 10.1 A
Oats
yield 27 bu

Field N 10.1 A
Oats
yield 27 bu

Field O 10.1 A
Oats
yield 27 bu

Field P 10.1 A
Oats
yield 27 bu

Field Q 10.1 A
Oats
yield 27 bu

Field R 10.1 A
Oats
yield 27 bu

Field S 10.1 A
Oats
yield 27 bu

Field T 10.1 A
Oats
yield 27 bu

Field U 10.1 A
Oats
yield 27 bu

Field V 10.1 A
Oats
yield 27 bu

Field W 10.1 A
Oats
yield 27 bu

Field X 10.1 A
Oats
yield 27 bu

Field Y 10.1 A
Oats
yield 27 bu

Field Z 10.1 A
Oats
yield 27 bu

INSTRUCTIONS

Draw a farm outline map showing all field boundaries.

Show in each field the following:

a. crop grown

b. acreage

c. crop yield

d. soil treatment

e. rate of application of each soil treatment

Show the kind and rate of application of each soil treatment.

Show fertilizer analysis. (Example: 4-16-8)

Show time of lime application.

Where only a portion of the field is treated, crosshatch the part or color as follows:

Manure Red or

Lime Green or

Fertilizer Blue or

Show grasses and legume sown with small grain as follows: O (Alb)

ABBREVIATIONS

C Corn

O Oats

B Barley

W Wheat

F Flax

T Timothy

a Acres

t Tons

S Soybeans

KB Ky. Bluegrass

SwC Sweetclover

Cl Clover

Alfalfa

Br Brome

bu Bushels

lb Pounds

Scale: 8 inches equals 1 mile

Figure 15. Farmers applied an increasing amount of fertilizer per acre in the 1960s to boost yields. Joseph Ludwig recorded fertilizer application on maps in his farm record books. This 1961 map shows that on field A, located on the west side of the farm, Ludwig applied 122 pounds of 5-20-20 fertilizer, most likely at planting time, and 150 pounds per acre of 33 percent nitrogen fertilizer to the growing crop to yield 85 bushels of corn per acre. On field H, just south of field, he applied 144 pounds of 5-20-20 starter fertilizer per acre and 250 pounds of nitrogen per acre to obtain the same yield as he did on field A. Schipull Papers. Special Collections, Parks Library, Iowa State University.

new gain-boosting ingredient

Stilbosol

(DIETHYLSTILBESTROL PREMIX, LILLY)

now available for record beef feeding profits...

A POWERFUL, gain-building ingredient is now available to help cattle feeders get more beef at a lower cost. It's *Stilbosol*.

Stilbosol boosts gains as much as 37% on high-corn fattening rations. Feed costs have been slashed as much as 20%.

Scientific experiments and on-the-farm feeding trials indicate that *Stilbosol* may be the most important advance in animal nutrition since the introduction of antibiotics as growth stimulants.

This is welcome news to cattlemen. Margins are tight. The dramatic, new development comes at a fortunate time to keep beef feeding profits from slipping.

FASTER, CHEAPER GAINS WITH *Stilbosol*

Research conducted by Iowa State College, Eli Lilly and Company, various feed manufacturers, and experienced cattle feeders check closely on the benefits of *Stilbosol*.

Rations containing proper *Stilbosol* levels have put an extra $\frac{1}{2}$ to $\frac{3}{4}$ pound of gain per day on fattening steers. Total gains have hit a record $3\frac{1}{2}$ pounds per day for sustained feeding periods of 70 to 112 days.

Cost of gain has been cut from 2 to 4 cents a pound. Profit margins have been increased by as much as \$25 to \$30 per steer with the use of *Stilbosol*-fortified rations. That's good anytime. It's especially welcome these days.

BENEFITS MANY KINDS OF RATIONS

While most dramatic results have occurred with high quality steers on high-corn rations, *Stilbosol* has stimulated considerable gain with many types of rations. This has been true whether fed to steers or heifers for slaughter. And, true, when fed to feeders of varying weights above 600 pounds.

JUST A PINCH DOES THE JOB

Stilbosol is exciting news from every angle. A little goes a long way. Your beef supplement manufacturer will mix 10 pounds of *Stilbosol* carefully into a ton of his brand of beef feed. The feed will look the same. It just packs more growth power.

When steers or heifers are fed 2 pounds per head daily of such *Stilbosol*-fortified supplement, they will receive the proper daily level of the growth stimulant. As usual, you use such supplements in your regular beef fattening ration.

Because it is so powerful, *Stilbosol* will be sold only to professional feed manufacturers. Need for extremely accurate mixing prohibits its home use.

CARCASS GRADE AND SELLING PRICE EQUAL

Cattle receiving *Stilbosol*-fortified supplements have been bringing at least equal prices when marketed. Dressing percentages and carcass grades have been essentially the same as check lots receiving no *Stilbosol*.

Cattle getting *Stilbosol* appear normal and act normal in all respects but three. They eat a little more, gain a lot faster, and make their gains more economically.

COSTS A LITTLE MORE...WORTH A LOT MORE

Supplements containing *Stilbosol* are expected to cost an extra \$7 to \$10 more per ton than the same supplement without the gain-booster.

At \$10 a ton extra, it'll cost you about 1¢ more per head per day. But that investment pays big dividends. Depending upon the kind of cattle and ration fed, *Stilbosol* has been returning \$10 to \$20 for every dollar invested in the growth stimulant.

Figure 16. Advertisement for "stilbosol," a marketing name for Eli Lilly and Company's stilbestrol laced feed. The remarkable growth enhancing properties of DES were regular features of advertisements for feed additives. *Successful Farming*, January 1955.

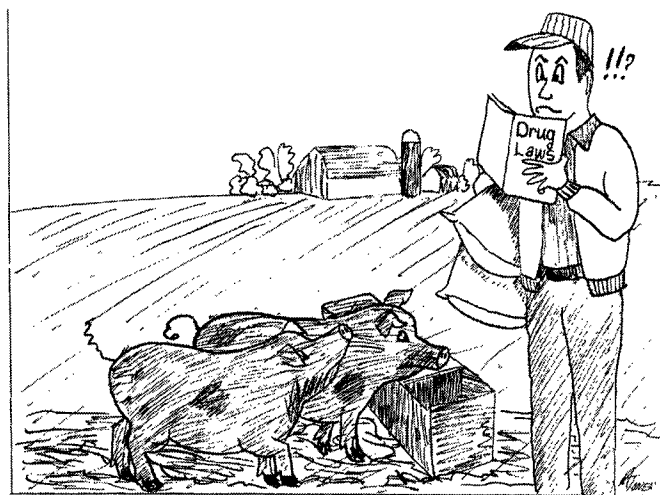


Figure 17. Farmers faced increasing restrictions on the use of feed additives in livestock rations as the 1970s began. This cartoon by an Iowa State University student suggests that the rules were becoming more complicated. Many Iowa farmers followed the rules for feeding antibiotics and growth hormones, but some farmers could not or would not do so. *Iowa Agriculturist*, Spring 1972.

MANDATORY DIETHYLSTILBESTROL (DES) CERTIFICATION

Required With Each Shipment of Cattle or Sheep
for Slaughter on and After January 8, 1972

In marketing _____ on _____
(number) (cattle, sheep) (shipping date)

I certify that these animals while in my possession for seven (7) days or longer:
(check one only)

- ☐ were not fed DES; or
- ☐ were fed DES in conformity with the feed or drug manufacturer's dosage directions, and were withdrawn as required by the Food and Drug Administration from feed containing DES at least seven (7) days prior to the shipment date specified above.

Signed _____

Address _____

IMPORTANT: All slaughtered animals are subject to inspection for drug residues. Animals containing unauthorized residues will be condemned and the parties responsible for these residues are subject to prosecution under the Food, Drug and Cosmetic Act.

Since January, producers have been required to certify that animals sold for slaughter have not been fed DES for at least seven days.

Figure 18. Beginning in 1972 the US government required farmers who sold livestock to certify that they did not feed diethylstilbestrol to their livestock or withdrew the additive from the ration at least seven days before sale. But DES residues were present in beef livers throughout 1972, the US government banned its use in livestock feed. Livestock farmers lost one of the valuable tools they used to cut the costs of production. *Iowa Agriculturist*, Spring 1972.

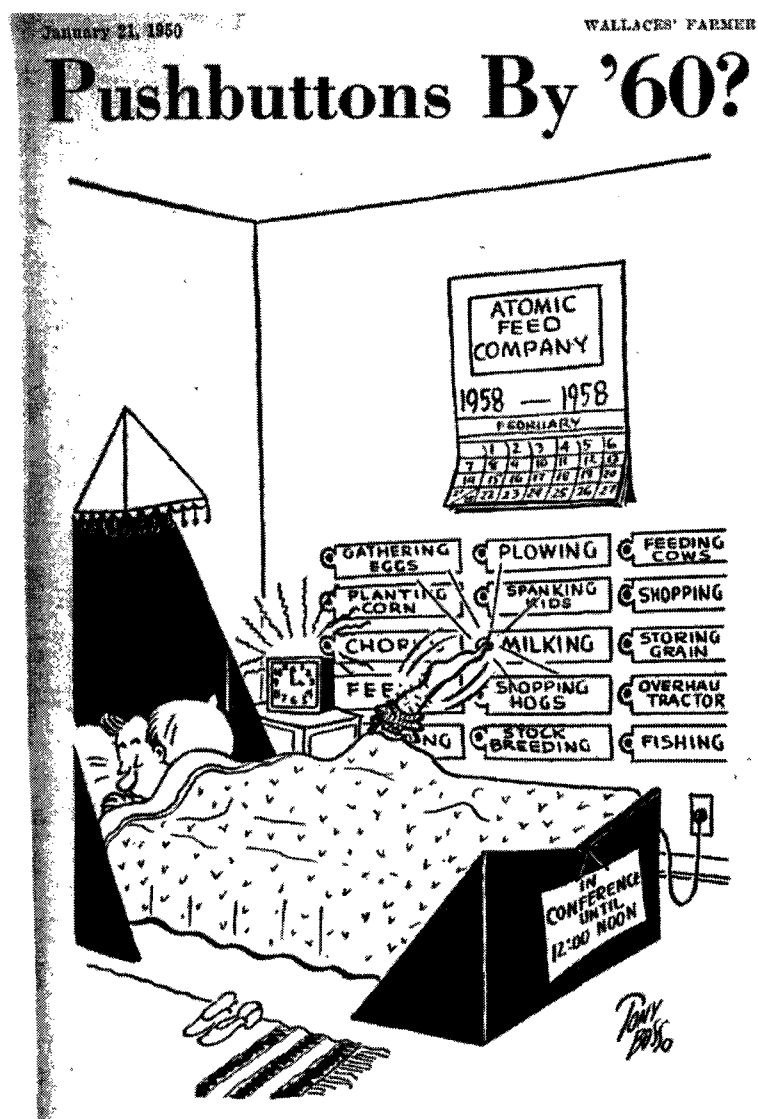


Figure 19. This 1950 cartoon exaggerated the potential of pushbutton technology for saving labor on the farm. Farmers who were accustomed to moving tons of feed, straw, manure, and milk every year liked the idea of automated materials handling systems. *Wallaces Farmer*, 21 January 1950.

"My DARI-KOOL Has Paid For Itself!"—

says William Tschudy, Route 5, Monroe, Wis.

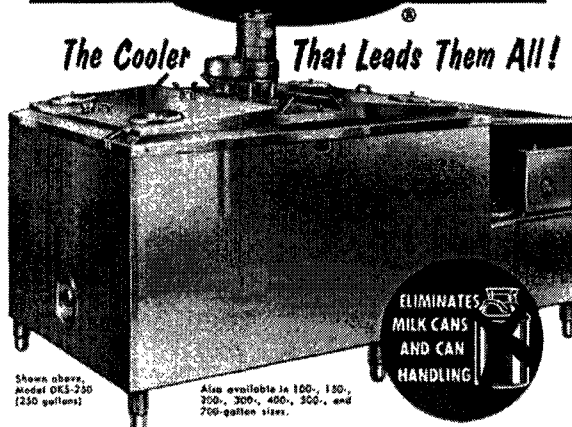
"By saving a minimum of 13 cents cwt. on milk volume and butterfat, which I formerly lost through milk can stickage and spillage, I figure my Dari-Kool has already paid for itself in less than 3 years of operation."



DARI-KOOL

BULK MILK COOLER

The Cooler That Leads Them All!



Shown above,
model DK-235
(250 gallons)

Also available in 100-, 150-,
200-, 300-, 400-, 500-, and
700-gallon sizes.

ELIMINATES
MILK CANS
AND CAN
HANDLING

•Cuts Work and Handling Costs •Improves Milk Quality

Milk is cooled to well below 40° in less than one hour, assuring a lower bacteria count and better milk. It is *impossible* to freeze milk in a Dari-Kool because the coolant is ice water.

Dari-Kool tanks are easy to clean and may be sanitized with hot water without damage. Units arrive ready to operate — nothing else to buy or maintain. Get the cooler that leads in sales—leads in value — leads in performance!

DARI-KOOL MEETS ALL 3-A SANITARY STANDARDS



Send Coupon for this NEW, FREE CATALOG!

DAIRY EQUIPMENT COMPANY

1444 East Washington Ave., Madison 10, Wis. Dept. 97

Please send me — no obligation — complete information on the advantages of Dari-Kool bulk milk cooling.

Name _____

Town _____

County _____

ZIP _____

State _____



Figure 20. Bulk tanks, combined with pipeline milking systems, allowed farmers to abandon the heavy work of moving milk from cow to milk can to cooler by hand. *Successful Farming*, February 1955.

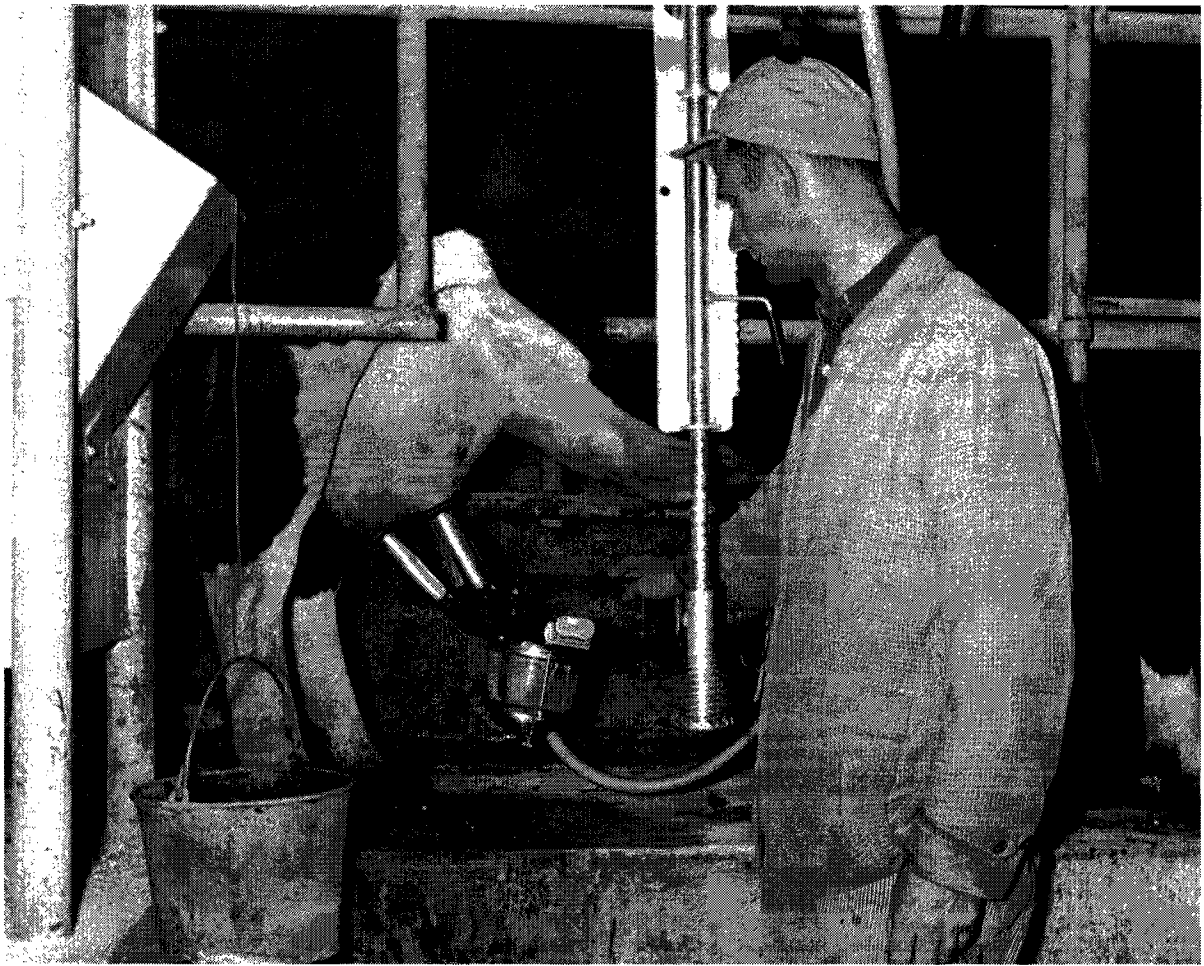
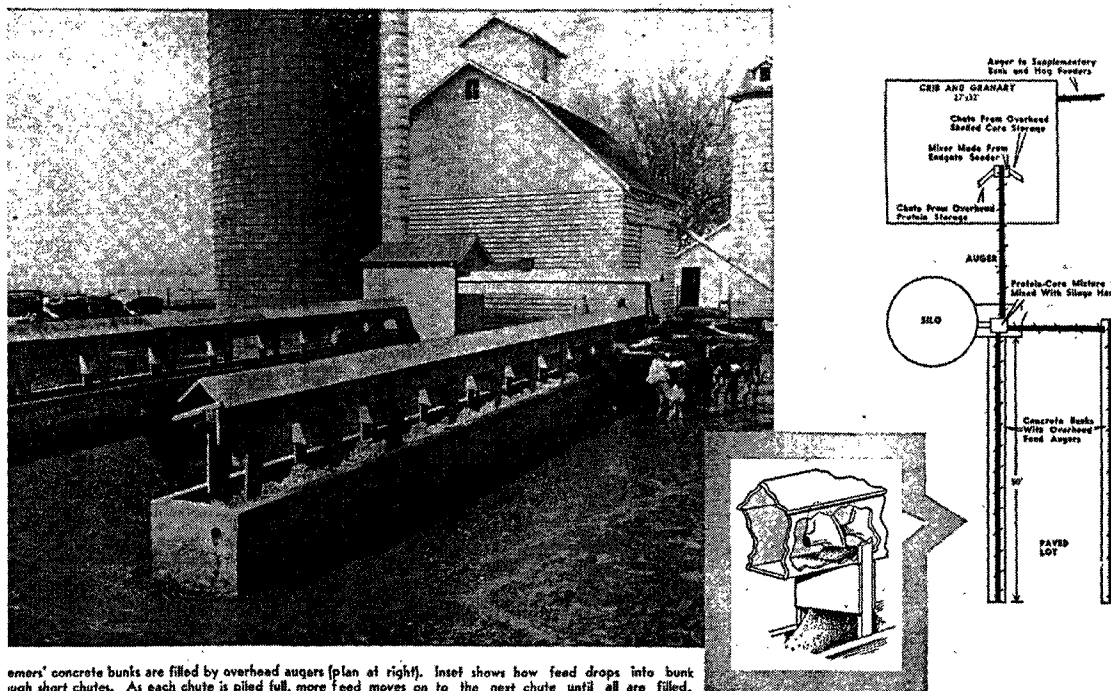


Figure 21. Modern milking parlors like this one allowed farmers to work more efficiently than in the old stanchion barns. Equipped with bulk tanks, pipeline milkers, and raised platforms, farmers could also work with more ease and comfort. Jim Depenbusch, pictured here, and his father milked a fifty cow herd when this photo was taken in April, 1964. *Wallaces Farmer*.

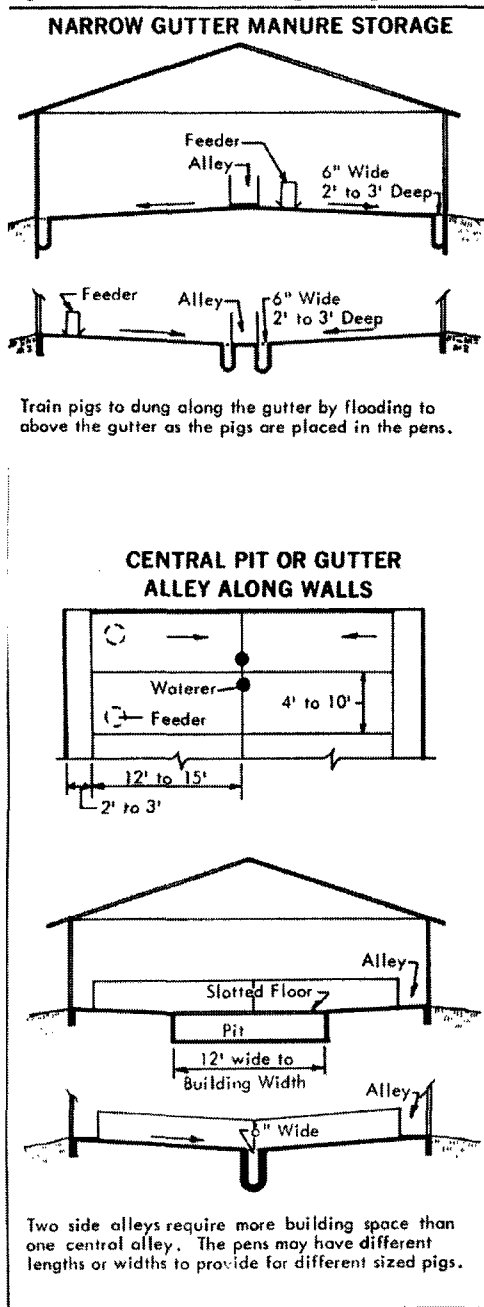


Wiemers' concrete bunks are filled by overhead augers (plan at right). Inset shows how feed drops into bunk through short chutes. As each chute is piled full, more feed moves on to the next chute until all are filled.

15 Minutes to Feed 135 Cattle

Figure 22. Automated feeding operations like this one used augers to replace human labor. Augers moved feed moved from the corn crib (rear) to the small shed (center) to be mixed with silage and then into the concrete bunks. The wooden frame over the bunk protected the auger and the feed from the weather. Orval Wiemers claimed that one person could feed 135 cattle in fifteen minutes. *Iowa Farm and Home Register*, 2 May 1954.

Figure 21b. Confinement finishing building:



S-14

Figure 22. Open-shelter buildings

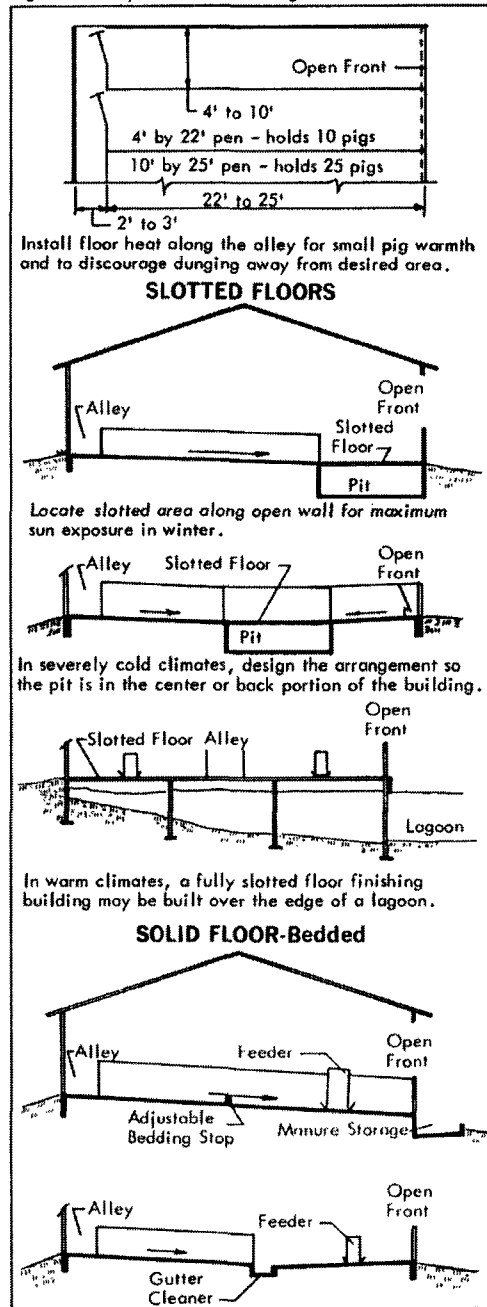


Figure 23. In the 1960s confinement feeding became a popular method of raising hogs among producers who wanted to specialize or engage in large scale production. Agricultural engineers played an important role in helping farmers to plan these new operations modeled on industrial ideals of efficiency and strict cost accounting. "Swine," *Midwest Plan Service Structures and Environment Handbook*, 1969 Edition. Records of the Midwest Plan Service. Special Collections, Parks Library, Iowa State University.



Figure 24. Automated feeding was easy with fence line feed bunks like this one. Farmers could avoid scooping feed, opening and closing gates, and getting stuck in muddy lots. Fred Hamilton of Pottawattamie County used this automatic unloading feed wagon in 1967. *Wallaces Farmer*, 11 February 1967.

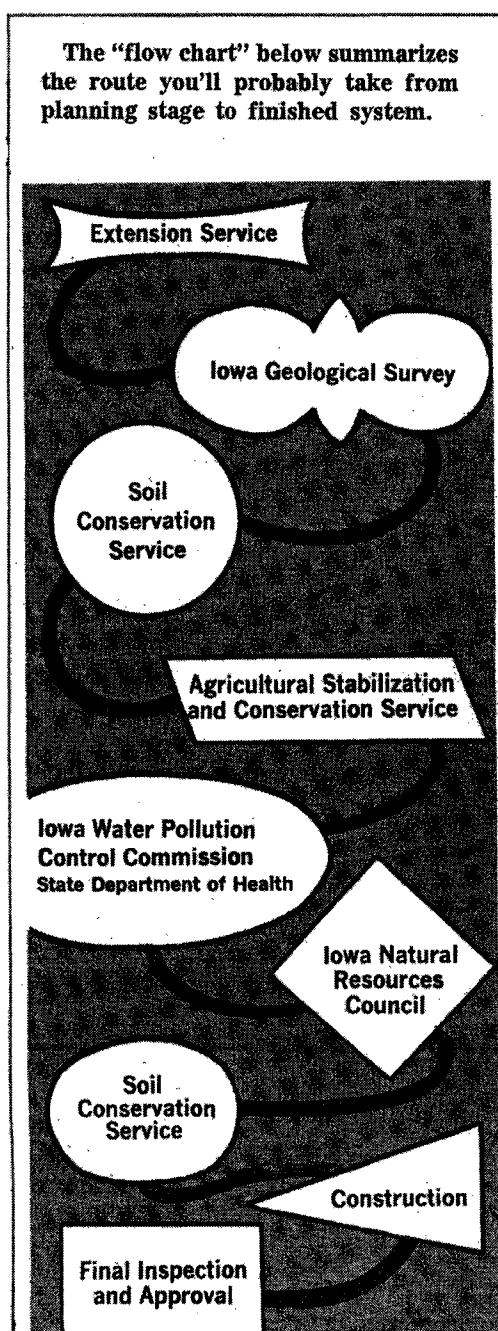


Figure 25. Creating a feedlot was a complicated job when the editors of *Wallaces Farmer* published this flow chart of the process in 1972. Responding to concerns about manure runoff and the potential for contamination of ground and surface water, state and national lawmakers acted to limit agricultural sources of water pollution. *Wallaces Farmer*, 26 February 1972.

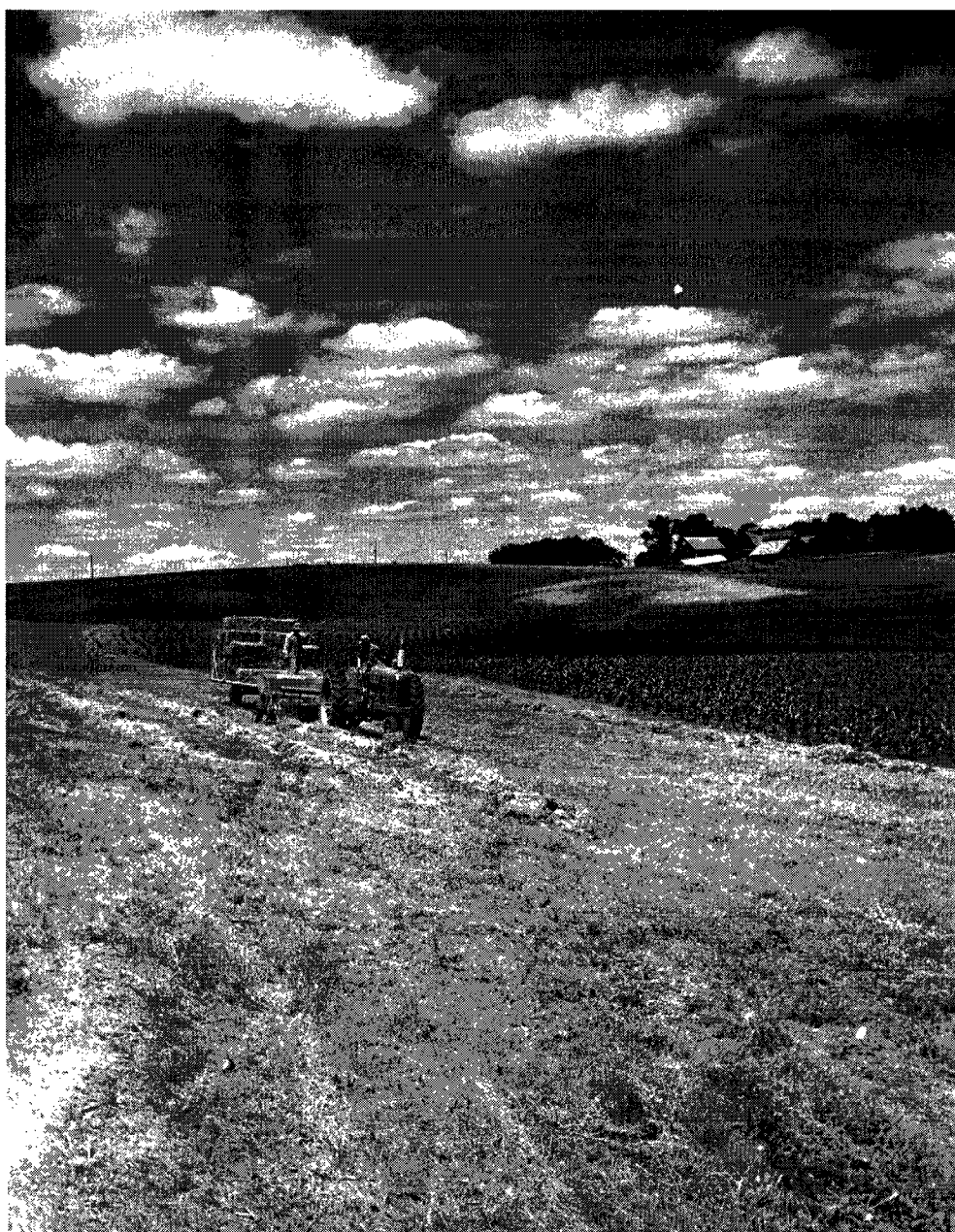


Figure 26. Making hay was a two man job with the self-tying hay baler that was commercially available in 1944. *Wallaces Farmer*, 24 June 1958.



Figure 27. Farmers who specialized in livestock production could make high quality forage by feeding chopped hay directly from the wagon or storing it as haylage. Gilbert Hoch, a Marion County hired man, is pictured chopping hay in 1950 on a farm near Knoxville. *Wallaces' Farmer and Iowa Homestead*, 2 June 1951.



Figure 28. Self-feeding haykeepers, designed at Iowa State College, permitted farmers to cut labor costs by reducing the amount of feed they handled for beef and dairy herds. This 1956 photograph of a dairy farmer, cows, and haykeeper is from Carroll County. *Wallaces Farmer*.



Figure 29. Newal Foust of Floyd County cut his oats with a windrower in preparation for combining in 1952. Farmers who used combines for their small grain harvest often cut the oats with a windrower a week to ten days before combining to let the grain cure in the field. *Wallaces Farmer*, August 1952.



Figure 30. A pick-up attachment on a tractor-drawn combine lifts the windrowed oats onto the combine to be threshed. Farmers found that they could use a combine for their small grain harvest and abandon the labor intensive work of community threshing rings. *Wallaces Farmer*, 20 June 1959.



Figure 31. Farmers considered soybean harvesting as a job for combines, even before soybeans and combines were common on Iowa farms. As farmers raised more soybeans they had more reason to use a combine since it could be used for two crops. This Hardin County farmer used his combine on his own farm and as a custom operator for a total of 140 acres of soybeans in 1962. Harvesting at night during good weather was preferable to waiting for daylight and risk losing bean pods in a severe storm. *Wallaces Farmer*, 5 October 1962.

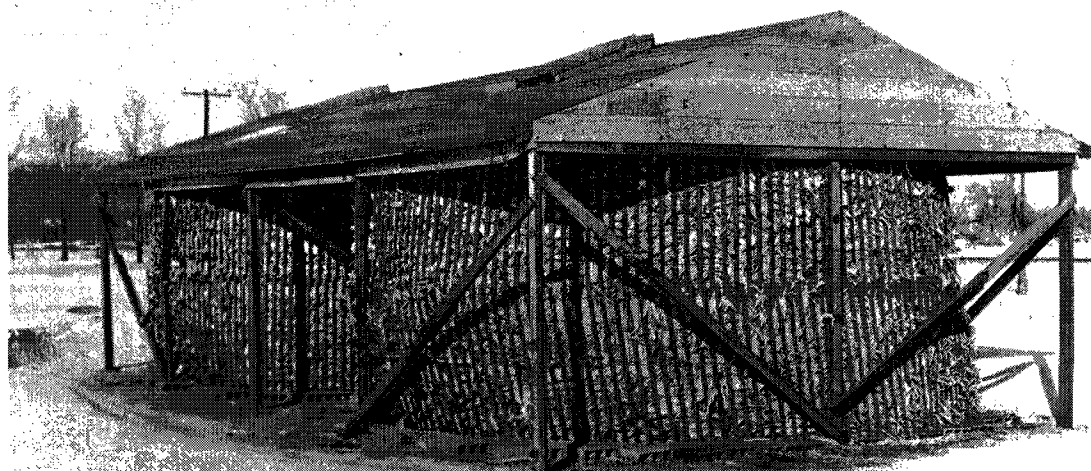


Figure 32. Farmers across the state constructed inexpensive temporary corn cribs from snow fence to store ear corn harvested by mechanical pickers. This roofed structure in Cerro Gordo County was more elaborate than most snow fence cribs. *Wallaces Farmer*, 20 August 1955.



Figure 33. Farm families built many new corn cribs in the 1940s and 1950s to deal with increased yields due to hybrid seed, fertilizer, and pesticides. Cribs like this one in Washington County were built to hold ear corn harvested by mechanical pickers. Changes in harvesting soon made these cribs obsolete. *Wallaces' Farmer and Iowa Homestead*, 6 August 1955.



Figure 34. In 1953 Homer Bugby of Dallas County used his picker-sheller to harvest ten acres of corn per day on three farms: his son's, son-in-laws and his own. Picker-shellers allowed farmers to harvest earlier than farmers with mechanical pickers and avoid the problems associated with pickers such as losing ears to ear drop due to European corn borer damage or inadvertently shelling part of the crop in the picker. *Wallaces Farmer*, 21 November 1953.

Combine Your Corn and Save Money

with the John Deere 45 Combine and Corn Attachment

Cut
SHELLED CORN
LOSSES 75%

Cut
EAR CORN
LOSSES 50%

Cut
STORAGE
SPACE 50%

Combine Corn
with 30 per cent
Moisture

Cut Your
Equipment
Investment

Make Top Money
Doing Custom
Work

ONE Investment in
ONE Machine Harvests
ALL Your Crops
Fast and Clean



CORN combining is here—and here to stay. The tremendous saving in money, in time, and in work made possible by the John Deere 45 Combine with Corn Attachment has won for it the highest regard of corn growers in all sections of the country. Owners report 75 per cent reduction in field shelling losses . . . 50 per cent reduction in ear corn losses—they tell of combining corn with 30 per cent moisture . . . and of getting cleaner corn that keeps better. Here is the proof that you, too, can make more money from your corn when it's harvested with a John Deere 45.

Reducing corn losses is only part of the success story of the 45 Combine. You cut storage space requirements in half . . . you leave husks

and cobs in the field . . . you have complete control of the corn attachment from the operator's platform—making corn harvests a safer and easier job. As a "bonus," you can make top money doing custom work.

You combine all your grain, bean, and seed crops by merely interchanging the corn attachment with the cutter bar platform. This operation takes less than an hour. You can combine corn in the morning, beans in the afternoon. Because you combine all combineable crops with this one efficient machine—your investment is spread over more acres—you save money on upkeep costs.

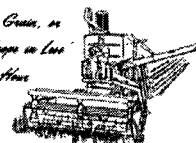
See your John Deere dealer in time to put a 45 on your farm this year.

Change from Corn to

Beans, Grass, or

Seed Crops in Less

Than an Hour



SEND FOR FREE LITERATURE

JOHN DEERE • Moline, Illinois • Dept. P45

Please send me your free folder on the John Deere 45 Corn Combine ☐ I would also like to have your free 36-page educational book on combining, drying, and storing of corn ☐.

Name _____ ☐ Student

R.R. _____ Box _____

Town _____ State _____



JOHN DEERE
QUALITY FARM EQUIPMENT SINCE 1857

Figure 35. Combines with special attachments called corn heads gained acceptance in the 1960s. Instead of owning a tractor-drawn combine for harvesting small grains and soybeans in addition to a corn picker or picker-sheller for the corn crop, farmers who purchased combines could harvest their entire grain crop with one machine. *Wallaces Farmer*, 4 August, 1956.

Corn States advises...

HARVEST EARLY

HARVEST IT ALL!

Heavy Corn Borer Damage
will cause many ears
to drop this fall! **HARVEST**
EARLY and you'll save
many bushels per acre.



ONLY \$2,295.00 WITHOUT WHEELS

This fall, more than any other in recent years, early harvest will pay big dividends. Harvest while the moisture content is high, before the ears drop. You can safely do it if you dry it in your own **CAMPBELL DRYER**, such as Model AF-18 shown above.

You'll save enough corn to more than pay for your drying costs . . . perhaps enough to pay for the dryer itself. You'll make more than you'd pay for gleaning or wastefully turning cattle and hogs into the field.

STORE IT SAFELY IN STEEL

Once harvested, be sure your corn will stay in perfect condition, store it in a B. S. & B. Perfection Grain Bin. No vermin can get in. Waterproof—with a special canopy roof. You'll never see such high quality at such a low price. Visit our exhibit at the Iowa State Fair.

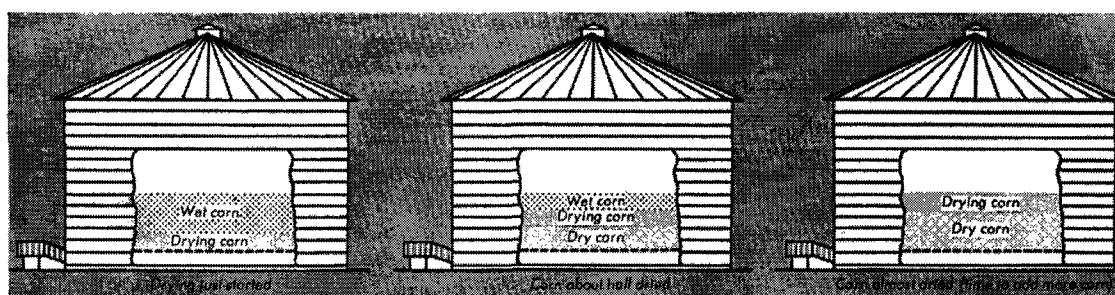
CALL COLLECT OR MAIL COUPON TODAY!

<p>CORN STATES HYBRID SERVICE 1101 Walnut St. DES MOINES, IOWA Telephone 8-7491</p>	<p>Send me all the facts on your Dryers and Grain Bins. Also name of nearest dealer.</p> <p>Name _____</p> <p>Address _____</p> <p>Town _____ State _____</p>
--	---

AND IOWA HOMESTEAD

91

Figure 36. Harvesting shelled corn was a viable technology choice for farmers if they could dry the grain enough to prevent spoilage in storage. Portable crop dryers like this one made it possible for farmers to use picker-shellers or combines for corn. *Wallaces Farmer*, 21 August 1954.



14

WALLACES FARMER

September 4, 1965

Figure 37.

Sukup **CONTINUOUS FLOW DRYING**
Choose Any System - Add On Anytime

STIRWAY
PRECISION STIRRING AUGERS — ONLY machine on the market that has positive stirring pattern. All auger driven (No Cables That Slip) Tested and proven at Iowa State University.

AIRWAY
DRIES GRAIN NEXT TO BIN WALL — by piping air through perforated pipes around bin walls. Eliminates Freezing. Farm tested and proven. Inexpensive to install.

FOREWAY
UNLOADS FROM THE BOTTOM — Evenly removes dried grains from the bottom continuously while wet grain from field is deposited on top . . . Here is the complete drying system.

Suggested Retail Price 24' Foreway Only \$1,250.00.

PROVEN ON-THE-FARM RESULTS!

"I harvest corn at about 25% moisture. And combine 2,000 bu. daily into a 9,000 bu. bin. Two stirring augers keeps corn level — dries fast enough to keep up with normal combining. Real satisfied. Wouldn't be without one."

Ray Frank
Riverside, Iowa

"It takes less gas to dry corn with a Stirway. Corn dries faster and more evenly—no wasteful overdrying of a bottom layer. Corn is kept all stirred so it dries faster and more uniformly. My Stirway has worked well, it does the job I want it to."

Harold Marth
Rockford, Iowa

"I harvest about 1500 bushels per day. Corn goes into a 6,600 bu. bin equipped with dryer, grain spreader, Stirway and Airways. The Stirway has been in 5 seasons and handles about 22,000 bu. a season. It's dependable — no adjustment problems."

Cecil Smith, Jr.
Iowa City, Iowa

Sukup Manufacturing Co. - Sheffield, Iowa

Figure 38.

Figure 37 shows the way a "drying front" moved through corn in a grain bin equipped for drying. As the forced, heated air moved through the grain and dried it, more grain could be added. *Wallaces Farmer*, 4 September 1965.

Corn did not always dry evenly in bins. Farmers such as Eugene Sukup designed stirring devices shown in Figure 38 to break up pockets of wet grain that could ruin the contents of a bin. *Wallaces Farmer*, 10 July 1971.

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ACKNOWLEDGEMENTS

I am pleased to recall the many people who helped me complete this project.

Doug Hurt has been steady in his friendship as well as his high expectations that I write something worth reading. Pam Riney-Kehrberg is an excellent mentor and friend who contributed much to my teaching and scholarship. In the early stages of research and writing Hamilton Cravens asked several important questions that improved the quality of my work. Jim Andrews and Jim McCormick read the entire manuscript and provided an informed critique. Iowa State University Extension faculty members Rich Pope, Bob Hartzler, Marlin Rice, and Ken Holscher read portions of the manuscript and made several valuable suggestions. Fellow students at Iowa State provided a good environment for studying history. They endured and improved several seminar papers that became four dissertation chapters. My friends and colleagues in the museum world were in my mind throughout this project. I wanted to write something that public historians who interpret agricultural and rural history would find useful.

I am grateful to the many people who consented to discuss their experiences in farming and extension work. It was a pleasure and a privilege to talk with people who lived through a time of tremendous change in production agriculture. I hope that they will find my account of farming to be an accurate representation of their experiences.

Skilled archivists and scholars made my work much easier and more pleasant. At the State Historical Society of Iowa, Sharon Avery provided valuable assistance in the Des Moines facility while Mary Bennett and Kevin Knoot helped in Iowa City. The Special Collections staff at Iowa State University, led by Tanya Zanish-Belcher, provided an excellent work environment, advised me on manuscript collections, screened films, and

cheerfully retrieved boxes of manuscripts day after day. Thanks especially to Michelle Christian, Becky Jordan, and Brad Kuennen who were on staff for all or most of the duration of my research. Paul Lasly, Ramona Wiersen, and Janet Huggard of the Iowa State University Sociology Department gave me access to the department's files of research reports. Frank Holdmeyer of Farm Progress Company and the staff of *Wallaces Farmer* were kind hosts during several days of work at their offices.

The State Historical Society of Iowa, Inc., of Iowa City provided a generous grant to defray research expenses. Beth Loecke patiently transcribed tapes of numerous interviews.

Ellen Garber at the University of Kansas was a friend from the first day I entered her office. I would not have completed a master's degree or started work towards a doctoral degree without her help.

Over the years my parents have supported me in many different ways. They seemed to know just what to do and what not to do. My grandparents provided my first glimpses of farming and shared many stories of their lives with me that served as inspiration for this project.

My wife Emma deserves the most thanks. Her encouragement and support have meant the world to me. I dedicate this project to her and my daughter.